

# **Appendix J**

## **404(b)(1) Evaluation**

**WORKING DRAFT**

April 27, 2016

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## Attachment

Attachment 1. Technology Assignment Rules

## Acronym List

µg/L	micrograms per liter
µs	microsiemens
AC	activated carbon
ACM	active channel margin
AINW	Archaeological Investigations Northwest, Inc.
AOC	Administrative Order on Consent
ARAR	applicable or relevant and appropriate requirement
BA	biological assessment
BaP	benzo(a)pyrene
BEHP	bis-2(ethylhexyl)phthalate
BERA	baseline ecological risk assessment
BHHRA	baseline human health risk assessment
BMP	best management practice
BO	biological opinion
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of concern
CRD	Columbia River Datum
CRITFC	Columbia River Inter-Tribal Fish Commission
CWA	Clean Water Act
DC	direct current
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DDx	DDD, DDE, and DDT
DEQ	Oregon Department of Environmental Quality
DMM	disposed material management
DO	dissolved oxygen
DSL	Oregon Department of State Lands

ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FMD	future maintenance dredge
FS	Feasibility Study
GAC	granular activated carbon
GIS	geographic information system
GPS	global positioning system
HEA	habitat equivalency analysis
HEC	Hydrologic Engineering Center
HQ	hazard quotient
HUC	hydrologic unit code
IC	institutional control
ITRC	Interstate Technology & Regulatory Council
LWD	large woody debris
LWG	Lower Willamette Group
MCL	maximum contaminant level
MLLW	mean lower low water
mg/L	milligrams per liter
mm	millimeters
MNR	monitored natural recovery
MOU	Memorandum of Understanding
NAPL	non-aqueous phase liquid
NAVD 88	North American Vertical Datum of 1988
NCP	National Contingency Plan
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRHP	National Register of Historic Places
NTU	nephelometric turbidity unit
ODFW	Oregon Department of Fish and Wildlife

ODHS	Oregon Department of Health and Human Services
OHA	Oregon Health Authority
OHW	ordinary high water
OSMB	Oregon State Marine Board
OSP	Oregon State Parks
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	primary constituent element
PeCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin
PeCDF	2,3,4,7,8-Pentachlorodibenzofuran
PHNRTC	Portland Harbor Natural Resource Trustee Council
POTW	publicly owned treatment works
PP&R	Portland Parks and Recreation
PRG	preliminary remediation goal
PTW	principal threat waste
RAL	remedial action level
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RHV	relative habitat value
RI	Remedial Investigation
RM	river mile
RNA	regulated navigation area
ROD	Record of Decision
Site	Portland Harbor Superfund Site
SHPO	Oregon State Historic Preservation Office
SMA	sediment management area
SOP	standard operating procedure
SPCC	Spill Prevention, Containment and Countermeasure
SWAC	surface area weighted average concentration
SWCA	SWCA Environmental Consultants
SWPPP	Stormwater Pollution Prevention Plan
TCDD	2,3,7,8- Tetrachlorodibenzo-p-dioxin

TEQ	toxic equivalent
TBT	tributyltin
TRV	toxicity reference value
TSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WDOE	Washington State Department of Ecology
WQMCCP	Water Quality Monitoring and Compliance Conditions Plan
WSDOT	Washington State Department of Transportation



## 1.0 INTRODUCTION

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The proposed action, which is described below, is being selected and implemented under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and must comply with applicable or relevant and appropriate requirements (ARARs). Section 404 of the Clean Water Act (CWA) and its implementing 404(b)(1) regulations (40 Code of Federal Regulations [CFR] Part 230) is an ARAR. The U.S. Environmental Protection Agency (EPA) has issued guidance on how cleanup actions in waters of the United States should be considered in remedy decision-making (EPA 1994). The purpose of this preliminary Section 404(b)(1) evaluation is to support EPA's findings regarding substantive compliance of the proposed action with this ARAR.

The 404(b)(1) analysis first determines whether an activity is water dependent. If it is, then upland alternatives do not need to be evaluated. Then, the potential impacts for each alternative, including a No Action alternative, are evaluated. Only practicable alternatives are evaluated. Practicable alternatives are those that are capable of being done given considerations of cost, logistics, and technology. This proposed action is being selected in accordance with CERCLA, the National Contingency Plan's (NCP) remedial action alternatives evaluation, including a comparison of the alternatives through the nine criteria provided for in the NCP. Thus, the NCP alternatives evaluation and analysis is used to determine practicability of alternatives. The detailed evaluation of alternatives and consistency with the CERCLA criteria is found in the Feasibility Study (FS). Therefore, this 404(b)(1) analysis document will focus on the alternatives identified as practicable in the FS and the No Action alternative only. The alternative development process and the alternatives are described in Section 2.

Section 404(b)(1) of the CWA requires that proposed actions be designed to avoid or minimize adverse impacts to aquatic resources and waters of the United States. Compensatory mitigation is considered only after other appropriate and practical options have been considered to avoid, minimize, or otherwise rectify unavoidable, adverse impacts on the aquatic environment, including impacts on aquatic species. Section 3 describes the existing environment and potential impacts of the No Action alternative and the proposed action. Section 4 summarizes issues related to the evaluation and testing of discharge material. Measures in the mitigation sequence to avoid, minimize, and finally compensate for potential impacts, are summarized in Section 5. Many of these measures are described in greater detail in the Programmatic Biological Assessment (BA). Section 6 provides the determinations of the 404(b)(1) analysis and a finding of the least environmentally damaging practicable alternative.

### 1.1 PROJECT BACKGROUND

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The Portland Harbor Superfund Site (Site) was evaluated and proposed for inclusion on the National Priorities List (NPL) pursuant to Section 105 of CERCLA and formally listed as a Superfund site in December 2000. The lead agency for this Site is EPA.

Several investigations of the Site have been conducted by Respondents to the



Administrative Settlement Agreement and Administrative Order on Consent (AOC), Docket No. CERCLA-10-2001-0240, (aka, the Lower Willamette Group [LWG]) for the Portland Harbor Remedial Investigation (RI) and FS (EPA 2001, 2003, 2006). As part of the RI, baseline ecological and human health risk assessments were completed (Windward 2011; Kennedy/Jenks Consultants [Kennedy/Jenks] 2013, respectively).

Oversight of LWG's Portland Harbor RI/FS is being provided by EPA with support from the Oregon Department of Environmental Quality (DEQ). EPA has entered into a Memorandum of Understanding (MOU) with DEQ, six federally recognized tribes, two other federal agencies, and one other state agency who have all participated in providing support in the development of the RI/FS.

The Site extends from river mile (RM) 1.9 to 11.8 as shown in **Figure 1-1**. Some river bank areas with known contamination are also included as part of the Site under the proposed action (**Figure 1-2**). The final boundaries for cleanup will be determined by EPA upon issuance of the Record of Decision (ROD). Currently, DEQ is investigating or directing source control work at over 90 upland sites in Portland Harbor and evaluating investigation and remediation information at more than 80 other upland sites in the vicinity (DEQ 2014). Additionally, DEQ is working with the City of Portland under an Intergovernmental Agreement to identify and control upland sources draining to the Site through 39 city outfalls and with the Oregon Department of Transportation on controlling sources in highway and bridge runoff drained to the Site (City of Portland 2012).

While the harbor area is extensively industrialized, it occurs within a region characterized by commercial, residential, recreational, and agricultural uses. Land uses along the lower Willamette River in the harbor include marine terminals, manufacturing, and other commercial operations as well as public facilities, parks, and open spaces. As discussed further in Section 2 of this document, EPA evaluated several remedial alternatives and will develop a Proposed Plan for the Site. The terms Site, harbor-wide, and site-wide used in this evaluation generally refer to the river sediments, pore water, and surface water within this reach of the lower Willamette River and not to the upland portions of the Portland Harbor Superfund Site.

This 404(b)(1) evaluation relies upon the information found in the RI/FS, its appendices, and the Programmatic Biological Assessment, which assesses potential effects on threatened and endangered species and critical habitat under the Endangered Species Act (ESA), another ARAR for the proposed action. These documents provide much greater detail on the implementation of remedial technologies and potential effects of specific technologies on listed species and critical habitat.

While this 404(b)(1) evaluation covers the full extent of remedial actions described in the FS, implementation of the selected remedial action will go through remedial design, which will determine the actual footprint of remediation areas and through which more details about how the remediation will proceed will be determined. Final and more specific avoidance and minimization measures and compensatory mitigation plans will be developed during the remedial design phase for the remedial action.

## 1.2 PROJECT PURPOSE AND NEED

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The basic purpose of the proposed action is to remove and remediate contaminated sediments within the Site, which is located within waters of the United States. The overall purpose of the proposed action is to reduce potential risks from contaminated sediments and surface water to acceptable levels consistent with the remedial action objectives (RAOs) established for the Site in the FS.

The need for the proposed action is based on the presence of chemicals of concern (COCs) in sediments, groundwater, surface water, and river banks in the Portland Harbor Superfund Site, as described in detail in the RI and further summarized in the FS. Most of the sediment contamination at the Site is associated with known or suspected historical sources and practices. Ongoing sources of contamination include contaminated groundwater plumes, river bank soils, stormwater and upstream surface water. Primary COCs in sediments at the Site include polychlorinated biphenyls (PCBs), dioxins/furans, pesticides, including DDT (with DDE and DDD, collectively DDx), chlordane, aldrin, and dieldrin, polycyclic aromatic hydrocarbons (PAHs), metals, and many others. Persistent contaminants (particularly PCBs and dioxin/furans) from sediments and surface water bioaccumulate in progressively higher trophic levels within the food chain.

The baseline human health risk assessment (BHHRA), developed as part of the RI, presents an analysis of the potential for effects associated with both current and potential future human exposures to COCs at the Site. Potential exposure to contaminants found in environmental media and biota was evaluated for various occupational and recreational uses of the river, as well as recreational, subsistence, and traditional and ceremonial tribal consumption of fish caught within the Portland Harbor site. Additionally, because of the persistent and bioaccumulative nature of many of the contaminants found in sediments, infant consumption of human breast milk was also quantitatively evaluated.

Based on the BHHRA, the Site poses unacceptable cancer risks and noncancer hazards from the consumption of fish or shellfish. PCBs are the primary contributor to risk from fish consumption harbor-wide. When evaluated on a river mile scale, dioxins/furans are a secondary contributor to the overall risk and hazard estimates. PCBs are the primary contributors to the noncancer hazard to nursing infants, primarily because of the bioaccumulative properties of PCBs and the susceptibility of infants to the developmental effects associated with exposure to PCBs.

The baseline ecological risk assessment (BERA) presents an evaluation of risks to aquatic and aquatic-dependent species within the Site. The BERA finds that 93 contaminants (as individual contaminants, sums, or totals) pose potentially unacceptable ecological risk. The list of contaminants posing potentially unacceptable risks can be condensed if individual PCB, DDx and PAH compounds or groups are condensed into three comprehensive groups: total PCBs, total DDx, and total PAHs. Doing so reduces the number of contaminants posing potentially unacceptable risks to 66.

The most ecologically significant COCs are PCBs, PAHs, dioxins and furans (as toxic

equivalent [TEQ]), and DDT and its metabolites. Total PAHs, total PCBs, total DDx have the greatest areal extent of unacceptable ecological risk. Of these, PAH and DDx risks are largely limited to benthic invertebrates and other sediment-associated receptors. PCBs tend to pose their largest ecological risks to mammals and birds.

### 1.3 OBJECTIVES

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RAOs were established for the Site in the FS. RAOs consist of media-specific goals for protecting human health and the environment. RAOs provide a general description of what the cleanup is expected to accomplish and help to focus alternative development and evaluation.

#### Human Health

- RAO 1 – Sediments: Reduce cancer and noncancer risks to people from incidental ingestion of and dermal contact with COCs in sediments and beaches to exposure levels that are acceptable for fishing, occupational, recreational, and ceremonial uses.
- RAO 2 – Biota: Reduce cancer and noncancer risks to acceptable exposure levels (direct and indirect) for human consumption of COCs in fish and shellfish.
- RAO 3 – Surface Water: Reduce cancer and noncancer risks to people from direct contact (ingestion, inhalation, and dermal contact) with COCs in surface water to exposure levels that are acceptable for fishing, occupational, recreational, and potential drinking water supply.
- RAO 4 – Groundwater: Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for human exposure.

#### Ecological

- RAO 5 – Sediments: Reduce risk to ecological receptors from ingestion of and direct contact with COCs in sediment to acceptable exposure levels.
- RAO 6 – Biota (Predators): Reduce risks to ecological receptors that consume COCs in prey to acceptable exposure levels.
- RAO 7 – Surface Water: Reduce risks to ecological receptors from ingestion of and direct contact COCs in surface water to acceptable exposure levels.
- RAO 8 – Groundwater: Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for ecological exposure.
- RAO 9 – River Banks: Reduce migration of COCs in river banks to sediment and surface water such that levels are acceptable in sediment and surface water for

human health and ecological exposures.

#### **1.4 WATER DEPENDENCY DETERMINATION**

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The proposed action addresses nearshore and offshore sediment contamination that is located within jurisdictional waters. The proposed action addresses surface water contamination through reducing COCs in sediments and reliance on upland source control actions. Because the contamination is located within water, upland-based remediation activities would not solely address the purpose and need of the project. Therefore, the proposed sediment remediation is a water-dependent activity (40 CFR § 230.10). However, disposal of materials removed for the purposes of the remediation is not a water dependent use, and disposal alternatives necessarily must include analysis of upland alternatives for that portion of the project, as described in Section 2.

## 2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

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### 2.1 PROJECT LOCATION

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The Site is located within the Lower Willamette River between RM 1.9 and RM 11.8, as shown in **Figure 1-1**. Some river bank areas with known contamination are also included as part of the Site under the proposed action (**Figure 1-2**).

The Site is broken up into four distinct areas as described in the FS: the navigation channel and future maintenance dredge areas, intermediate areas, shallow areas, and river banks. These designations were used to support the assignment of remedial technologies and the evaluation of remedial action alternatives in the FS. The navigation channel and the future maintenance dredge (FMD) region encompasses the federally authorized navigation channel and areas near and around docks based on information regarding vessel activity, dock configuration, and future site uses where maintenance dredging is likely to occur. FMD locations were developed from estimates of likely future navigation depth requirements and potential future maintenance dredging depths near and around docks. A description of how the FMD locations were determined is provided in Appendix C. The intermediate region is defined as outside the horizontal limits of the navigation channel and FMD region to the bathymetric elevation of 4 feet North American Vertical Datum of 1988 (NAVD88). The shallow region is defined as shoreward of the bathymetric elevation of 4 feet NAVD88. The river bank region refers to contaminated river banks identified in Section 1.2.3.5 of the FS. Alternatives also encompass upland areas for temporary storage of dredged material and debris, and dewatering activities, as well as transloading facilities and permanent upland disposal sites.

### 2.2 REMEDIAL ALTERNATIVES DEVELOPMENT/BACKGROUND

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The proposed action was developed based on the evaluation of remedial action alternatives presented in the FS and conducted in accordance with CERCLA and the NCP, which entailed a comparison of the alternatives through the nine criteria provided for in the NCP.

Development of remedial alternatives is described in detail in Section 3 of the FS. The process for alternative development began with establishing RAOs. The RAOs, outlined in Section 1 of this document, consist of media-specific goals for protecting human health and the environment. Preliminary remediation goals (PRGs) were then identified based on the results of the baseline human health and ecological risk assessments, chemical-specific ARARs, when available, and consideration of background concentrations. PRGs represent concentrations in environmental media that are protective of both human and ecological receptors for each RAO. The area where contamination in sediments exceeds the human health PRGs in the RI/FS Study Area is approximately 2,450 acres (essentially the entire RI/FS Study Area from RM 1.9 to RM 11.8). However, the area where sediments exceed the ecological PRGs is 1,520 acres (64 percent of the Study Area). Based on this information, the entire river area from RM 1.9 to RM 11.8,

including some river banks, is evaluated for actions under CERCLA authority because the area contains COC concentrations that exceed the PRG for at least one contaminant or are a potential source of contamination to the river. However, the entire river area may not need physical construction activities, such as capping or dredging, for the remedy to achieve remedial action objectives and cleanup levels.

To facilitate the development of remedial action alternatives, remedial action levels (RALs) were established. RALs are contaminant-specific sediment threshold concentrations used to identify the areas requiring capping or dredging and establish sediment management area (SMA) boundaries. RALs were developed by considering the relationship between the spatial extent of contamination exceeding the RAL concentration (acres of capping or dredging) and the surface area weighted average concentrations (SWACs). A range of RALs consisting of six different concentrations was developed for each of the six focused COCs (PCBs, total PAHs, 2,3,7,8-Tetrachlorodibenzo-p-dioxin [TCDD], 1,2,3,7,8-Pentachlorodibenzo-p-dioxin [PeCDD], 2,3,4,7,8-Pentachlorodibenzofuran [PeCDF, and DDX) for development of the remedial alternatives, as described in the next section.

Remedial technologies were assigned for each SMA based on anthropogenic and environmental site conditions. A multi-criteria decision matrix was used to score technologies based on multiple criteria related to hydrodynamics (wind/wave zones, erosive or depositional conditions, and depth), sediment bed characteristics (slope and substrate), and anthropogenic conditions (structures/pilings, prop wash zones, and debris). Three technology assignment decision processes were then developed for: (1) areas that are within the federally authorized navigation channel (navigation channel) or designated as FMD, (2) shallow areas, and (3) intermediate areas. Within these areas, technologies were assigned based on several factors, including the presence of principal threat waste (PTW), presence of heavy structures, depth of contamination, and others.

These multi-criteria decision matrices were used to apply technologies across the Site and are the basis for the calculations of remedial areas and volumes defined for each alternative. Footprints of each technology assignment were developed in the FS based on the current dataset that EPA has for the Site; however, these footprints are subject to change based on new site information collected during remedial design. This may result in changes to the area and volume of sediment contamination requiring remediation but will not change the basic remedial technologies that have been assigned.

## **2.2.1 Alternatives Evaluated in the Feasibility Study**

Nine remedial alternatives were developed in the FS (as described in detail in Section 3 and Section 4 of the FS), including the No Action alternative (designated as Alternative A). The No Action alternative does not include any containment, removal, disposal, or treatment of contaminated sediments, no new institutional controls, and no new monitoring. There would be no construction or physical disturbance of the environment under this alternative.

Eight remedial alternatives (designated as Alternatives B through I) were assembled by combining the remedial technologies and associated process options to address focused COCs above PRGs in sediments across the Site. Technologies were assigned based on site-specific characteristics so that remedial approaches most appropriate for site conditions (anthropogenic and environmental) would be applied within each SMA. Each of the eight remedial alternatives applies the same suite of remedial technologies and process options to varying degrees based on the range of six RALs. The primary difference between Alternatives B through I is the size of the footprint of removal and containment based on the area of the SMAs defined for each alternative. Alternative H has the largest footprint of removal and containment, with those technologies applied to all contaminated sediments at the Site.

Alternative I applies technologies based on more stringent RALs in certain areas to ensure that cancer risk and noncancer hazard levels throughout the Site will be within an acceptable range. In other areas, Alternative I applies technologies under less stringent RALs while requiring that all PTW is still addressed. Alternative I is the preferred alternative, or proposed action, as described in the next section.

A summary of the Remedial Alternatives evaluated in the FS is presented in **Table 2-1**.

## **2.2.2 Selection of the Proposed Action**

The proposed action was selected in accordance with CERCLA, the NCP's remedial action alternatives evaluation, including a comparison of the alternatives through the nine criteria described in the NCP. The three criteria used for the initial screening of alternatives (see FS Section 3) are effectiveness, implementability, and cost:

**Effectiveness-** All the alternatives are effective in reducing risks from COCs at the site. Alternative B relies on less construction and more MNR to reduce risks and each alternative thereafter relies on more construction and less MNR. Alternatives that take longer to reduce risks from COCs at the site due to a greater reliance on MNR are considered less effective than those that reduce risks more quickly.

**Implementability-** All alternatives are implementable, with the amount of construction increasing from Alternative B through Alternative H. (Alternative I, the proposed action, entails less construction than Alternative H, as explained below). However, given the extensive degree of capping and dredging associated with Alternative H and the expected construction duration (62 years), Alternative H is considered less implementable than the other alternatives.

**Cost-** Cost is proportional to the amount of construction and materials needed for each alternative. Thus, costs increase from Alternative B to Alternative H. (Alternative I, the proposed action, is less costly than Alternative H).

EPA RI/FS guidance (USEPA 1988) notes that the entire range of alternatives originally developed do not need to be carried through the detailed analysis if all alternatives do not

represent distinct viable options. Based on the information provided in the screening tables of the alternatives, Alternatives C and H were eliminated from consideration of the detailed analysis in Section 4 of the FS. Alternative C was eliminated because it was not distinctly different than Alternative B. Alternative H was eliminated based primarily on implementability and cost.

Section 4 of the FS provides a detailed analysis of the remaining six remedial alternatives and the No Action alternative against each of the NCP evaluation criteria and a comparative analysis that focuses upon the relative performance of each alternative against those criteria. Based on this analysis, each of the six remedial alternatives meets the seven threshold and balancing criteria: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. **Table 2-2** presents a summary of the comparative analysis of alternatives conducted in the FS. Alternatives C and H are not included in this summary because they were screened out as described above.

One of the primary differences among the remedial alternatives is the time it would take to achieve RAOs. Alternative B would take the longest to achieve some RAOs because of the greater magnitude of residual risks that would remain as compared to other alternatives. These residual risks would result from areas that are not addressed by capping, dredging, in-situ treatment or enhanced natural recovery (ENR). Alternative B would also have the greatest dependence on the effectiveness of monitored natural recovery (MNR) and adherence to institutional controls (ICs) to meet the PRGs.

Based on the evaluation presented in the FS, EPA identified Alternative I as the preferred alternative, also known as the proposed action. This alternative represents the ideal application of technologies across the Site based on the seven threshold and balancing criteria. The remaining two criteria- state and community acceptance- will be evaluated through the FS public review process.

## **2.3 DESCRIPTION OF REMEDIAL TECHNOLOGIES**

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This section describes each of the remedial technologies. The assignment of remedial technologies follows a set of key assumptions and decision rules that are described in Attachment 1.

### **2.3.1 Institutional Controls**

Existing Oregon Health Authority (OHA) fish consumption advisories would continue under the proposed action. Further, enhanced outreach to educate community members about the OHA consumption advisories, emphasizing that advisories would remain in place during and after remediation, would be incorporated into the active remedial alternatives. Outreach activities would focus on communities (typically communities or groups with environmental justice concerns) known to engage in sustenance fishing, with a special emphasis on sensitive populations (children, pregnant women, nursing mothers, tribal members). These activities could also include posting multilingual signs in fishing



areas, distributing illustrated, multilingual brochures, and holding educational community meetings and workshops.

Additional institutional controls, such as waterway and land-use restrictions or special conditions to protect the integrity of engineered caps, imposed on sediment disturbance activities would also be implemented as components of alternatives comprising active remedial measures.

### **2.3.2 Monitored Natural Recovery**

Natural recovery typically relies on ongoing, naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants in sediment. These processes may include physical (burial and sedimentation or dispersion and mixing), biological (biodegradation), and chemical (sorption and oxidation) mechanisms that act together to reduce the risk posed by the contaminants. However, not all natural processes result in risk reduction; some may increase or shift risk to other locations or receptors. MNR includes monitoring of the water column, sediment, and biota tissues to assess whether these natural processes continue to occur and at what rate they may be reducing contaminant concentrations in surface sediment. MNR does not include active remedial measures. However, should monitoring determine that natural recovery is not occurring as expected, additional sediment cleanup and source control actions may be required. This would be determined through the CERCLA 5-year review process.

### **2.3.3 Enhanced Natural Recovery**

ENR refers to enhancement or acceleration of natural recovery processes to reduce risks within an acceptable time frame. As with MNR, ENR entails monitoring to assess whether natural processes continue to occur and at what rate they may be reducing contaminant concentrations in surface sediment. Areas that are stable (exhibit low shear stress) and are recovering naturally are candidates for ENR. ENR would be applicable to broad areas of the Site with lower levels of contamination, net sedimentation, and where significant erosion is not a concern.

A 12-inch layer of clean material (e.g., sand) would be used to accelerate natural recovery through several processes, including dilution of contaminant concentrations in sediment and decreasing exposure of organisms to the contaminated sediment. A thin-layer cover is typically different than an isolation cap because it is not designed to provide long-term chemical and physical isolation of contaminants, and does not require that the layer be maintained.

The grain size and organic carbon content of the clean sediment to be used for a thin-layer cover would be selected to approximate common substrates found in the area and provide suitable habitat for benthic organisms native to the Lower Willamette River. Clean sediment can be placed in a uniform thin layer over the contaminated area or it can be placed in berms or windrows, allowing natural sediment transport processes to distribute the clean sediment to the desired areas.

### 2.3.4 Containment

Containment entails the physical isolation (sequestration) or immobilization of contaminated sediment by an engineered cap, thereby limiting potential exposure to, and mobility of, contaminants under the cap. Caps are designed to reduce potentially unacceptable risks through: (1) physical isolation of the contaminated sediment or soil to reduce exposure due to direct contact and to reduce the ability of burrowing organisms to move contaminants to the surface, (2) stabilization and erosion protection to reduce re-suspension or erosion and transport to other sites, and/or (3) chemical isolation of contaminated media to reduce exposure from contaminants transported into the water column. Capping technologies require long-term monitoring and maintenance in perpetuity to ensure that containment measures are performing successfully because contaminated sediment is left in place.

Caps are generally constructed of granular material, such as suitable fine-grained sediment, sand, or gravel, but can have more complex designs. Engineered sand caps, with and without stone armor, were selected as the representative process option for alternatives involving sediment containment. Caps would be designed with different layers (including “reactive” capping layers that provide treatment) to serve these primary functions, or in some cases, a single layer may serve multiple functions. Reactive caps were considered for areas where there are groundwater plumes, contaminants that have higher water solubility in areas with significant groundwater advection (the process by which contaminants are transported by flowing groundwater), or where thinner caps are needed in order to minimize any potential change in flood elevations. Specific cap types included in the FS include:

- Significantly augmented reactive cap (17” fine-grained low permeability sand, 1” organoclay mat, 12” medium sand)
- Reactive cap (12” sand with 5 percent granular activated carbon [GAC], 24” sand)
- Reactive cap with beach mix (12” sand with 5 percent GAC, 18” sand, 6” beach mix)
- Reactive armored cap (12” sand with 5 percent GAC, 12” sand, 12” armor stone) in areas where PTW is present, within a groundwater plume area
- Reactive armored cap with impermeable layer (6” Aquablok, 6” beach mix) in areas where PTW is present, outside a groundwater plume area
- Engineered cap (36” sand)
- Engineered cap with beach mix (30” sand, 6” beach mix)
- Armored cap (24” sand, 12” armor stone)

### **2.3.5 In-Situ Treatment**

In-situ treatment of sediments refers to chemical, physical, or biological techniques for reducing contaminant concentrations, toxicity, bioavailability, or mobility while leaving the contaminated sediment in place. While capping is focused on physical isolation of contaminants, in-situ treatment is used in areas where it is possible to enhance the degradation or absorption of contaminants in addition to isolation.

In-situ treatment likely would entail sequestration by addition of an amendment, such as activated carbon to the sediments, which modifies the sorption capacity of non-polar organics and certain metals such as mercury. Amendments can be engineered to facilitate placement in aquatic environments by using an aggregate core (such as gravel) that acts as a weighting component and resists re-suspension so that the mixture is reliably delivered to the sediment bed where it breaks down slowly and mixes into sediment by bioturbation.

The FS assumed that in-situ treatment will be accomplished through the placement of 12 inches of AquaGate with an activated carbon content of 5 percent by weight. Site-specific treatability studies may be required during remedial design to determine the effectiveness of the treatment technology in the environment of the Site and develop specific design characteristics such as the activated carbon application rate.

### **2.3.6 Sediment/Soil Removal**

Removal of sediments can be accomplished either while submerged (dredging) or after water has been diverted or drained (excavation). Both methods typically necessitate transporting the sediment to an offloading facility for dewatering followed by transport to a Subtitle D or Subtitle C/Toxic Substances Control Act (TSCA) landfill. For non-aqueous phase liquid (NAPL) and/or not reliably containable PTW, treatment through solidification/stabilization or thermal desorption would be required prior to disposal. Treatment of water from dewatered sediment prior to discharge to an appropriate receiving water body may also be required. It should be noted that there is ongoing navigation dredging throughout the site to maintain waterways for recreational, national defense, and commercial purposes.

The FS assumed that sediments would be removed using mechanical dredging techniques. Environmental/closed buckets and fixed arm dredges are the preferred method for dredging. However, cable-operated dredges may be required in certain conditions such as where water depths exceed 40 feet. In addition, traditional clamshell buckets may be required in certain areas such as where there is significant rip rap or debris. The specific method for sediment removal will be determined during remedial design.

Following dredging, a 12-inch sand layer would be placed over the leave surface to cover the exposed surface and isolate any dredge residuals and remaining contaminated sediment. In nearshore areas, this would be followed by placement of beach mix, consisting of rounded gravel typically 2.5 inches or less.

It is assumed that land-based excavators would be used for removal of contaminated river bank materials or near-shore sediments in locations above the water level. This would limit offsite transport of disturbed river bank materials by the river. It is assumed that removal of river bank material would be conducted in the late summer and early fall when river stage is low.

### **2.3.7 Ex-Situ Treatment**

Ex-situ treatment involves the application of chemical, physical, or biological technologies to transform, destroy, or immobilize contaminants following removal of contaminated sediments. Depending on the contaminants, their concentrations, and the composition of the sediment, treatment of the sediment to reduce the toxicity, mobility, or volume of the contaminants before disposal may be warranted. Available disposal options and capacities may also affect the decision to treat some sediment. Regulatory requirements may influence the need for treatment (such as Resource Conservation and Recovery Act [RCRA] Land Disposal Restrictions) and a determination that some portion of the material constitutes PTW and, as such, treatment would be considered. Ex-situ treatment technologies evaluated in the FS include thermal treatment and solidification/stabilization using quicklime.

Dewatering of dredged sediments would be required prior to ex-situ treatment. Dewatering is described in Section 2.3.8.1.1.

### **2.3.8 Disposal**

Disposal refers to the placement of dredged or excavated material and process wastes into a temporary or permanent structure, site, or facility. Disposal of dredged or excavated material is not a water dependent use. The goal of disposal is generally to manage sediment and/or residual wastes to prevent contaminants associated with them from impacting human health and the environment.

Disposal of removed media can either be within an upland landfill disposal facility, such as operating commercial landfills, or within an in-water disposal facility specifically engineered for the sediment remediation such as in a confined disposal facility (CDF). Confined aquatic disposal (CAD) is another option that would entail in-water placement of dredged material followed by subaqueous covering or capping such that aquatic habitat would be retained to some extent. Due to interference with federal navigation use, the CAD was screened out (see FS Section 2).

Landfill disposal options considered in the FS include disposal in a RCRA Subtitle D landfill and RCRA Subtitle C or TSCA landfills. Off-site disposal locations retained in the FS (Section 3) include several commercial landfills: Roosevelt Regional Landfill (Subtitle D), and Chemical Waste Management of the Northwest (Chem Waste) Landfill (Subtitle C; accepts RCRA waste).

There are two dredged material management (DMM) scenarios evaluated; DMM Scenario 1 evaluates a combination of onsite (i.e. CDF) disposal and offsite disposal, and

DMM Scenario 2 evaluates exclusive offsite disposal. The locations and/or facilities assumed to be representative for evaluation purposes are identified in Section 2.4.5 of the FS. As discussed in Section 3.8.1 of the FS, DMM Scenario 2 is the representative approach evaluated in the FS because it can apply to all alternatives. DMM Scenario 1 is only applied to Alternatives E through I because the estimated dredge volumes under these alternatives are adequate for placement of the CDF, as described in Section 2.3.8.2 below. The cost savings that could result from use of a CDF for alternatives that are conducive to a CDF are presented in Appendix G of the FS.

The sediment and soil disposal decision considerations described in Sections 2 and 3 of the FS are used to guide the process to determine appropriate disposal options for dredged material. The considerations that determine what type of facility can accept dredged or excavated contaminated sediments and river bank soils are complex and include factors such as timing of the work, location within the site, regulatory requirements, and facility acceptance requirements. Thus, the ultimate disposal location of dredged or excavated materials is indeterminable until remedial design. However, there are significant restrictions on placement of dredged or excavated materials for placement in a CDF under DMM Scenario 1 in the form of Portland Harbor-specific CDF performance standards as presented in Table 3.3-8 and Section 3.4.9.2 of the FS.

The performance criteria would significantly limit the ability of PTW (which includes NAPL, NRC, and highly toxic wastes) to be disposed in the CDF. For purposes of the FS, there is sufficient volume of non-PTW contaminated sediment for alternatives that evaluate DMM Scenario 1 to assume the CDF receives this material in lieu of PTW, which would be transported off-site for disposal. Off-site disposal and disposal in an on-site CDF are further described below.

### **2.3.8.1 Upland (Off-site) Disposal**

Dredged sediments meeting certain criteria would be disposed of at upland landfill disposal facilities. Prior to transport, sediments would be dewatered, and the wastewater would be treated, as described below. Transport options are also discussed.

#### **2.3.8.1.1 Dewatering**

Dewatering technologies are commonly used to reduce the amount of water in dredged sediment and prepare the sediment for transport and treatment or disposal. In many cases, the dewatering effluent will need to be treated before it can be disposed of properly or discharged back to receiving water. Dewatering also would occur with ex-situ treatment. Several factors would be considered when selecting an appropriate dewatering treatment technology, including physical characteristics of the sediment; selected dredging method; and the required moisture content of the material to allow for the next handling, treatment, transport, or disposal steps in the process. Project-specific dewatering technologies will be determined during remedial design based on the characteristics of the removed sediment and transport/treatment/disposal requirements.

Three categories of dewatering that are regularly implemented include passive

dewatering, mechanical dewatering, and reagent enhanced dewatering/stabilizing methods. These methods are often used in combination to address project-specific dewatering requirements.

### **Passive Dewatering**

Passive dewatering (also referred to as gravity dewatering) is facilitated through natural evaporation, consolidation, and drainage of sediment pore water to reduce the dredged sediment water content. It is most often conducted at an onshore temporary holding facility such as a dewatering lagoon or temporary settling basin. In-barge settling and subsequent decanting can also be an effective passive dewatering method and can reduce the overall time needed for onshore passive dewatering operations. Water generated during the dewatering process is typically discharged to receiving waters directly after some level of treatment or may be captured and transported to an offsite treatment and discharge location. Normal passive dewatering typically requires little or no treatability testing although characteristics of the sediment, such as grain size, plasticity, settling characteristics and NAPL content, are typically considered to determine specific dewatering methods, size the dewatering area, and estimate the time frame required for implementation.

Passive dewatering is generally effective and capable of handling variable process flow rates but can require significant amounts of space (depending on the volume of material processed and the settling characteristics of the sediment) and time for significant water content reduction. Passive dewatering is a widely implemented dewatering technology for mechanically dredged sediments. It is also amenable to hydraulic dredging with placement into a settling basin or with the use of very large geotextile tubes to confine slurry and sediment during passive dewatering. Hydraulic dredge sediment dewatering with geotextile tubes has been implemented at several sites but typically requires project-specific bench-scale evaluations during remedial design to confirm its compatibility with Site sediments and properly select and size the geotextile tubes. Under this method, geotextile tubes would be placed in upland locations.

### **Mechanical Dewatering**

Mechanical dewatering involves the use of equipment, such as centrifuges, hydrocyclones, belt presses, or plate-and-frame filter presses, to separate coarse materials or squeeze, press, or otherwise draw water out from sediment pore spaces. Mechanical dewatering is typically used in combination with hydraulic dredging to reduce the water content of the dredged slurry prior to ex-situ treatment (e.g., thermal) and/or disposal of the dewatered sediment.

The mechanical dewatering treatment train typically includes screening to remove materials such as debris, rocks, and coarse gravel. If appropriate, polymers may be added for thickening prior to dewatering. These steps result in a dewatered cake that achieves project-specific volume and weight reduction goals for the dredged sediment. The mechanical dewatering process can be scaled to handle large volumes of sediment but requires operator attention, consistent flow rates, and consistent sediment feed quality.

## **Reagent Dewatering**

Reagent dewatering is an ex-situ treatment method in the category of stabilization/solidification methods. This technology removes water by adding a reagent to the bulk sediment that binds with the water within the sediment matrix to immobilize the leachable contaminants (typically metals) and/or enhance geotechnical properties. This process increases the mass of the sediment due to the addition of the reagent mass. For situations where dewatering is the single goal, the most cost-effective, available, and effective reagent or absorptive additive is used, which, depending on site conditions and economics, could include quicklime, Portland cement, fly ash, diatomaceous earth, or sawdust, among others. Reagent mixtures can be optimized to provide enhanced strength or leachate retardation to meet specific project requirements.

Dewatering by the addition of reagents is effective and has similar or smaller space and operational requirements as compared to mechanical dewatering. In some cases, reagent addition and mixing can be conducted as part of the dredged material transport and handling processes, either on the barge or as dredged material is loaded into trucks or rail cars. In other cases, it can be added and mixed after offloading to an upland staging area. Also reagent addition may be used in combination with other forms of dewatering (e.g., filter press) and ex-situ treatment. The Gasco Early Action project, for example, used in-barge application and mixing of Portland cement as well as diatomaceous earth at the transload facility as a final dewatering “polishing” step. This approach required no extra upland treatment space or major changes to the transport and transload steps that would have been needed otherwise.

### **2.3.8.1.2 Wastewater Treatment**

Dewatering dredged material requires managing the wastewater generated during the dewatering process (dredged material typically has a water content ranging from 50 to 98 percent, depending on the dredging method) along with contact water (such as precipitation that has been in contact with contaminated material, decontamination water, and wheel wash water) from other facility operations. The purpose of wastewater treatment is to prevent adverse impacts on the receiving water body from the discharge of dewatering water to the Lower Willamette River.

Wastewater will be generated by dewatering steps, and this water likely will either require treatment prior to discharge to the Lower Willamette River or disposal at a publicly owned treatment works (POTW) facility. While the FS necessarily assumes a representative set of process options for the general screening and alternative development procedures, this does not imply that other process options are screened out from future consideration during remedial design. Unless specifically noted otherwise, all process options discussed in this section would be potential options during remedial design. For example, there may be opportunities for handling and discharging wastewater, including addition of amendments to bind or absorb water, use of upland transfer or disposal holding areas to allow water to clarify before discharge, and discharge to publicly operated existing treatment facilities.

A wastewater treatment plant may be included as part of the on-site management of dredged material. An on-site wastewater treatment plant to manage wastewater for a facility handling sediment from the Portland Harbor Site may include coagulation, clarification, multi-stage filtration, and granular activated carbon adsorption with provision for metals removal, if necessary. The primary difference in the wastewater treatment plant for a hydraulic dredging operation as compared to a mechanical dredging operation would be the volume of wastewater to be treated. As hydraulic dredging results in a larger volume of sediment-water slurry to be managed, a hydraulic dredging wastewater treatment plant would require a larger footprint.

#### **2.3.8.1.3 Transportation**

Transportation is a necessary component of removal of contaminated sediments from the Portland Harbor Site. The transportation method would be based upon the compatibility of that transportation method to the other process options. The most likely transportation methods are truck, rail, and barge, and/or a combination of these. They are briefly discussed below.

##### **Truck Transport**

Truck transportation includes the transport of dewatered dredged material over public roadways using dump trucks, roll-off boxes, or trailers.

##### **Rail Transport**

Rail transportation includes the transport of dewatered dredged material via railroad tracks using gondolas or containers. Rail transport is desirable where sediment is shipped over long distances, for example, to out-of-state treatment or disposal facilities. Rail transport may require the construction of a rail spur from a sediment handling facility to a main rail line.

##### **Barge Transport**

Barge transportation includes the transport of dredged solids directly to a processing (dewatering) or onsite disposal (CDF) facility or the transport of dewatered dredged material to a transloading facility for transport to an upland disposal facility. Barge transport likely would be used for short distances such as from the dredging location to the dredged material handling facility. In addition, barge transport may be considered for longer distances if dredged material is hauled to treatment or disposal locations that have the ability to accept barge-loaded dredged material. Sediment would be dredged from SMAs within the Site, loaded onto barges, taken to a transloading facility where it would be prepared for upland transportation, and transferred to rail or truck, and then transported to the landfill for disposal. Potential upland disposal facilities are shown in **Figure 2-1**.

##### **Transloading of Sediments and Debris**

Transloading of sediments and debris will be conducted at an upland offload facility in the Lower Columbia River, likely upstream of the Willamette River confluence. Improvements at the offload facility may include berth improvements, fencing, pavement



improvements, stormwater management berms and other stormwater management, watertight transload box installation, drying agent storage, lined containment areas if storage is required, a truck lining station, a truck covering station, a wheel wash, and a dry decontamination station.

Any new impervious surface created as part of the proposed action will comply with NMFS stormwater treatment and detention requirements (NMFS 2014).

### **2.3.8.2 Confined Disposal Facility (CDF)**

Under DMM Scenario 1 (for Alternatives E through I), dredged material would be disposed of within a CDF, an in-water disposal facility specifically engineered for sediment remediation. As described in the FS, construction of a CDF was considered in Slip 1 of the Port of Portland's Terminal 4, Swan Island Lagoon or offshore of the Arkema site (**Figure 2-2**). The Terminal 4 CDF location could accommodate approximately 670,000 cubic yards of contaminated sediments, while approximately 1,400,000 cubic yards of contaminated sediments could be accommodated at the Swan Island Lagoon CDF based on the conceptual design. The Arkema CDF location would have a more limited capacity, as only Arkema material would be placed there.

All three potential CDF locations were evaluated in the FS (see Section 7.6 of this document for further discussion). The Terminal 4 CDF location was retained as a representative option in the FS.

Based on a conceptual plan (Anchor QEA 2011), a CDF at Terminal 4 could contain 670,000 cubic yards of dredged contaminated sediments. This estimate does not include an additional 200,000 cubic yards of contaminated sediments capacity that may be gained by consolidation settlement of the placed material as the facility is filled. The volumetric capacity of the CDF relative to the estimated volume of sediment to be dredged from the Site and acceptable for placement is a factor in determining the viability of constructing a CDF. Approximately 150 percent of the 670,000 cubic yard volume capacity of the CDF, or approximately 1,005,000 cubic yards, was assumed in the FS to be dredged from the Site to ensure sufficient quantity of material to justify the CDF's construction. Alternatives B through D would not meet the 1,005,000 cubic yards of sediment threshold to justify construction of a CDF.

A CDF at Terminal 4 would fill approximately 15 acres of aquatic habitat (Anchor QEA 2011). Construction would entail demolition of overwater structures and pilings and

construction of the containment berm at the mouth of Slip 1 (including dredging a 5 - to

10 - foot - deep “key” beneath the proposed containment berm location at approximately

- 40 feet National Geodetic Vertical Datum [NGVD]). This sediment would be removed

from its current location and placed at the head of Slip 1 prior to containment berm construction.

The CDF berm would be constructed at a 2:1 side slope, with the exception of a more gently sloped bench (20 percent or 5:1) on the outside face of the berm (**Figure 2-3**). The gently sloped bench on the outside face of the berm was incorporated into the design to reduce the net loss of shallow water habitat in Slip 1 (Anchor QEA 2011). In this way, there would be an improvement in the slope and shoreline conditions along the face of the berm compared to the existing steep-sloped shoreline. This would reduce some of the loss of shallow water habitat important for aquatic species.

Once construction of the CDF berm is complete, the CDF would be fully enclosed from the river, and placement of sediments into the CDF would not be considered in-water work.

Construction of the CDF berm would include a weir and outfall structure that would be used to drain water from the CDF as it is being filled with sediment. This structure would consist of a pipe and a weir structure through which effluent, when necessary, would outlet at the waterward face of the containment berm into the Willamette River. During filling, as water within the CDF begins to approach a level at which discharge would be necessary, filling would be slowed or stopped to prevent overflow. If discharge is necessary, water quality within the CDF would be sampled and characterized prior to discharge to confirm that water quality criteria will be achieved at the point of discharge from the CDF, to be established through agency consultation on ESA and to comply with the substantive requirements of CWA Section 401. A detailed water quality monitoring plan similar to that being developed with the Port of Portland would be required.

The 60 percent design indicates the surface cover of the CDF would consist of two layers. The lower layer, located above the confined contaminated sediment, would consist of suitable fill or dredged sediments that meet EPA’s “imported material” requirements established in the December 2003 Technical Plans and Specifications for the McCormick & Baxter sediment cap. The top layer is the surface cover layer and assumed to be compacted crush rock in the current design (Anchor QEA 2011). Following completion of a CDF at Terminal 4, it may be possible for the Port of Portland or its tenants to utilize the land created by the CDF for water-dependent uses.

### 2.3.9 Removal and Installation of Piling and Structures

Some piles and structures will need to be removed during dredging and capping. Temporary structures may also be installed for work area isolation, transloading, sediment containment, or fish exclusion during construction. Obsolete piles and dilapidated structures with low function, permanence, and lifespan may be removed. Major and minor structures with medium to high function, permanence, and lifespan are expected to remain in place. Temporary docks are expected to be relocated to allow access to contaminated material. Marine salvage equipment will likely be used to remove structures. Piles can either be removed or cut off at the base using divers. At many locations, creosote treated piling may be replaced with a different piling type, which would remove a minimal source of PAHs to the sediment.

## 2.4 PROJECT DESCRIPTION

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The proposed action consists of remedial technologies to be implemented at the Site to reduce potential risks from contaminated sediments and surface water to acceptable levels consistent with the RAOs established for the Site in the FS. Remedial actions focus on reductions in concentrations of contaminants in sediment and river bank soils. The proposed action includes implementation of remedial technologies to address concentrations of contaminants in sediment and river bank soils and disposal of contaminated sediments in a CDF. These remedial actions, in conjunction with source control measures implemented under state or federal authority, are anticipated to reduce concentrations in other media such as groundwater, stormwater, surface water, upland soils, and air.

Based on the evaluation presented in the FS, EPA identified Alternative I as the preferred alternative, also known as the proposed action. The footprint of removal and containment for the proposed action is shown on **Figure 2-11(a-f)**. The footprints of each of the other remedial alternatives are shown on **Figure 2-4a-f** through **Figure 2-10a-f**. The areas of each assigned technology for each alternative, including the proposed action, is presented in detail in **Table 2-3**. Information on material volumes is provided in **Table 2-4** for the Site and **Table 2-5** for river banks. The expected years to complete construction under each alternative is provided in **Table 2-1**.

## 2.5 PROJECT SCHEDULE

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In-water construction activities for the proposed action would be constructed within the in-water work window between July 1 and October 31 (122 days per year). Dredging is assumed to occur 24 hours per day and 6 days per week. As described in the FS (Section 3.6), based on estimated dredge volumes and production rates and estimated cap material volumes and application rates, in-water construction activities are estimated to take approximately 5 years to complete<sup>1</sup>. An additional 1 year is assumed for pre-construction set-up/mobilization and 1 year for post-construction de-mobilization, for a total

<sup>1</sup> It is assumed that the CDF would be constructed prior to initiating the in-water construction activities, would take 4 years to fill, and 6-12 months to construct a cover.

construction duration of 7 years. As described in Section 4 of the FS, it is anticipated that it will take several years of MNR to reach RAOs across the Site.

### 3.0 POTENTIAL IMPACTS

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This section provides an analysis of potential impacts of remedial activities based on conditions set forth in the EPA Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230). Section 230.11 of Subpart B of the guidelines provides the four conditions that must be met in order to make a finding that a proposed discharge complies with the requirements described in 40 CFR 230.

These four conditions include:

1. No discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem so long as the alternative does not have other significant adverse environmental impacts.
2. No discharge of dredged or fill material shall be permitted if it violates any water quality standards, jeopardizes any endangered or threatened species, or disturbs any marine sanctuaries.
3. No discharge of dredged or fill material shall be permitted that will result in significant degradation of any waters of the United States, including adverse effects on human health or welfare or effects on municipal water supplies, aquatic organisms, wildlife, or special aquatic sites.
4. No discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken that will minimize potential adverse impacts.

As described in Section 2, the proposed action includes remedial activities to be conducted primarily in the Lower Willamette River, from RM 1.9 to 11.8. In addition, dredged contaminated sediment and soil removed from the Site would be transported within the federally authorized navigation channel down the Lower Willamette River to the Lower Columbia River and upstream on the Lower Columbia River to a potential transloading facility. Most of the significant adverse impacts of the proposed action are generally expected to occur in the Lower Willamette River where active remediation would occur. Potential impacts related to the transport and offloading of contaminated sediments at a transloading facility on the Lower Columbia River are described in Section 3.5.

#### 3.1 POTENTIAL IMPACTS ON PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

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Potential impacts on the aquatic ecosystem are primarily associated with (1) removal of contaminated sediment by dredging, (2) containment or in-situ treatment of contaminated sediment by the placement of a cap or amendment such as activated carbon, and (3) in-water disposal of contaminated sediments in a CDF. Activities associated with ENR technologies, including placement of clean material (12 inches of sand), and in-situ treatment (placement of activated carbon) would also have impacts on the physical and

chemical characteristics of the aquatic ecosystem. Such impacts would not be anticipated from the application of MNR or institutional controls; therefore, these technologies are not addressed in the impact evaluation.

Under Alternative A (No Action), no active effort would be undertaken to remediate the sediments within the Site, and only baseline or current conditions are evaluated. For each of the other alternatives, the remedial technology assignments are shown in **Figure 2-4a-f** through **Figure 2-11a-f**. Acres assigned to dredging are primarily within the navigation channel and FMD areas. Nearshore areas would be treated with a mix of technologies: dredging along the shoreline in shallow areas subject to wind and vessel wake action and capping and ENR farther offshore and beneath structures. A summary of the acreage assigned to capping, dredging and ENR technologies by alternative is presented in **Table 2-1**.

The Site is within a working harbor with ongoing industrial activities and contains a federally maintained navigation channel, extending nearly bank-to-bank in some areas, which allows transit of large ships into the active harbor. The navigation channel is maintained to a depth of minus (-)40 feet with an authorized depth of -43 feet, and extends from the confluence of the lower Willamette River with the Columbia River to RM 11.7. In addition, the Port of Portland and other private entities periodically perform maintenance dredging to support access to dock and wharf facilities. Dredging activity has greatly altered the physical and ecological environment of the river in Portland Harbor.

Much of the shoreline contains overwater piers and berths, port terminals and slips, and other engineered features. Armoring covers approximately half of the harbor shoreline, which is integral to the operation of industrial activities that characterize Portland Harbor. Riprap is the most common bank-stabilization measure. However, upland bulkheads and rubble piles are also used to stabilize the banks. Seawalls are used to control periodic flooding as most of the original wetlands bordering the Willamette in the Portland Harbor area have been filled. Constructed structures, such as wharfs, piers, floating docks, and piling, have been built largely to accommodate or support shipping traffic within the river and stabilize the river banks for urban development. Some river bank areas and adjacent parcels have been abandoned and allowed to revegetate, and beaches have formed along some modified shorelines due to relatively natural processes.

The proposed action must achieve the project purpose (i.e., sediment remediation to achieve the remedial action objectives established for the Site) in a manner that is consistent with the current and future maritime uses of the river and harbor, and minimize temporary disruptions of these activities.

Development of the river has resulted in major modifications to the ecological function of the lower Willamette River. However, a number of species of invertebrates, fishes, birds, amphibians, and mammals, including some protected by the ESA, use habitats that occur within and along the river. The river is also an important rearing site and pathway for migration of anadromous fishes such as salmon and lamprey. Various recreational

fisheries, including salmon, bass, sturgeon, crayfish, and others, are active within the lower Willamette River. A detailed description of ecological communities in Portland Harbor is presented in the BERA provided as **Appendix G** of the RI report.

### 3.1.1 Substrate

This section discusses physical and chemical characteristics associated with the substrate, including material composition, elevation and topography, shoreline conditions, and contaminants. Biological characteristics, including the benthic community, are discussed in Section 3.2.2.

#### 3.1.1.1 Existing Conditions

In general, with no anthropomorphic impacts, substrate size and location is an indicator of a river's energy regime. Low energy regimes allow for smaller substrates, such as silt and clay, to settle out and build up, whereas high energy environments continually wash smaller sediments away, leaving behind larger and coarser substrates such as sand, gravel, and cobble. Much of the Lower Willamette River is dominated by sands. The Lower Willamette River widens between RM 11.0 and 10.0 and allows for a mosaic of sand, silt, and other mixed textures. The finest substrates<sup>2</sup> are located between RM 10.0 and 7.0 where the Lower Willamette River is the widest. Significantly coarser substrates overlaying finer material are found in highly developed areas along the middle and the upper end of the Site (LWG, as modified by EPA 2016). **Figure 3-1** shows the existing substrate conditions within the Site.

**Figure 3-2a-e** shows shallow water areas with benthic forage potential. These areas were determined as those having small substrate size (less than 64 millimeters [mm]) with no debris covering the substrate. Although these areas contain benthic forage potential, they may be impacted by the presence of chemical contamination that limits forage opportunities. It is also important to note that SMA-specific studies completed during remedial design may draw different conclusions as to the characteristics of the existing habitat.

LWG conducted a sidescan sonar review of the Study Area in 2009, which identified scattered debris on the river bottom throughout the Study Area (see **Figure 3-3a-d**). The debris included miscellaneous unidentifiable objects as well as sunken ships, anchors, concrete slabs, and steel and wooden piles. As part of the remedial alternatives, the anthropogenic debris identified in the remedial action areas will be removed, returning the river bottom to more natural conditions.

**Figure 3-3a-d** also shows the shoreline condition within the Site as determined by the LWG shoreline condition line dataset and assumes the shoreline condition extends throughout the active channel margin (ACM) zone. Note that SMA-specific studies may draw different conclusions as to the characteristics of the existing habitat. As a result of

<sup>2</sup> Fines are defined as sediments less than 63 microns in diameter that would pass through a No. 230 U.S. Standard sieve mesh. Based on the Wentworth Size Class, this includes coarse silt, medium silt, fine silt, very fine silt, and clay.

filling, channelizing, and other shoreline modifications that have occurred since the 1850s, steep shoreline slopes are common throughout the Lower Willamette River. In the Willamette Basin, these types of shoreline hardening alter the velocity and timing of river and streamflows, disconnect rivers and streams from their floodplains, and limit the establishment of native vegetation and the natural maintenance of gravel beds, which has an impact on the character of the substrate in the Lower Willamette River (Willamette Restoration Initiative 2004).

#### **3.1.1.2 No Action**

The No Action alternative will not result in impacts on the existing physical and chemical characteristics associated with the substrate. The current degraded conditions would continue to exist.

#### **3.1.1.3 Dredging**

Removal of contaminated sediments through dredging will change the elevation and material composition of the substrate. The FS assumes that slopes in nearshore areas would be restored to a slope of 5H:1V, where possible, following remedial activities. Following dredging, a 12-inch thick sand layer will be placed over the dredged area to cover the exposed surface and isolate any dredge residuals and remaining contaminated sediment. In addition, dredging in nearshore areas would be followed by placement of beach mix, consisting of rounded gravel typically 2.5 inches or less, in nearshore areas. This layer would provide appropriate substrate habitat for colonization by benthic organisms. Exceptions to this are where armoring in erosional areas is required, as described in the next section.

Following excavation of contaminated soils on river bank areas, river bank slopes would be restored to a slope of less than 5H:1V where possible; however, current industrial and commercial operations may have structures that preclude obtaining this desired slope following remedial action. Additionally, many of the contaminated river banks extend into upland areas that preclude removal of the contamination to PRGs. Consequently, caps and other erosion control measures will likely need to be placed on much of these banks, as described in the next section.

The placement of a clean sand residuals cover layer and/or beach mix (in nearshore areas) will provide an improvement over current physical substrate conditions in some locations by replacing anthropogenic debris or large rock with sand and/or gravel. In areas where armoring is required, adverse impacts to substrate would require compensatory mitigation to replace lost habitat and forage area, as described in Section 6.

Impacts of dredging on the aquatic food web are discussed in Section 3.2.2.

#### **3.1.1.4 Capping, In-Situ Treatment, and ENR**

As described in Section 2.3.4, several types of caps will be implemented in various portions of the Site: engineered caps, armored caps, reactive caps, and armored reactive caps. Engineered caps consist of a sand layer with an additional top layer of beach mix in



shallow areas. Armored caps would be needed for erosional areas and would consist of a sand layer with a top layer of armor stone. Armored caps are also assumed to be placed at river banks where the slope exceeds 1.7H:1V and at river banks in the main channel that are prone to erosive forces.

In areas where groundwater contamination has the potential to discharge to the river, reactive caps would be needed and would consist of a sand layer mixed with activated carbon, an additional layer of sand on top of the reactive layer, and beach mix at the surface in shallow water areas to provide appropriate substrate for foraging habitat. Armored reactive caps would be needed to secure reactive caps in erosional areas with an additional layer of armor stone. Reactive caps would also include significantly augmented reactive caps in areas where NAPL or not reliably contained PTW is left in place following removal. Significantly augmented reactive caps consist of 17 inches of fine-grained low permeability sand, 1 inch of organoclay mat, 12 inches of medium sand, and a surface stabilization layer. For intermediate, navigation channel/future maintenance dredging areas, and shallow areas beneath structures, the surface stabilization layer is defined as 6 inches of armor stone. For shallow areas that are not beneath structures, the surface stabilization layer is defined as 6 inches of beach mix.

Cover materials for capping, in-situ treatment, and ENR would be selected to approximate common substrates found in the area and provide suitable habitat for benthic organisms native to the Lower Willamette River. As with dredging, beach mix consisting of rounded gravel typically 2.5 inches or less would be applied to the uppermost layer of all cap surfaces in nearshore areas.

The placement of engineered caps with riprap armor is limited to areas below heavy structures and as part of significantly augmented reactive caps. Placement of armoring materials in shallow water areas where there is currently no armoring would have an adverse impact to shallow water habitat by permanently altering the substrate. However, re-deposition of fine-grained material in capped and armored areas is anticipated to occur over time, making the armored areas similar in surface grain size to non-armored areas. Compensatory mitigation to replace lost habitat and forage area from the placement of armor stone would be required, as described in Section 6.

Overall, containment technologies will alter the chemical conditions of the substrate and result in benefits to the aquatic ecosystem by reducing exposure to contaminants in sediment, porewater, and surface water. However, the use of beach mix, where feasible, is expected to help minimize the adverse impacts of capping-based technologies on shallow water habitat.

#### **3.1.1.5 CDF**

The construction of a CDF would result in long-term impacts on substrate, as existing nearshore aquatic area available for benthic and water column foraging will be eliminated through filling to become upland. This adverse impact would require compensatory mitigation to replace lost habitat and forage area, as described in Section 6.

### **3.1.1.6 Removal and Installation of Piles and Structures**

The removal of piles and structures prior to dredging and capping and their replacement following construction, if required, would not significantly alter the substrate. Structures installed for transloading, work area isolation, sediment containment, or fish exclusion during construction would be removed following construction; therefore, no permanent alteration to substrate is expected from these activities.

### **3.1.2 Suspended Particulates/Turbidity and Dissolved Oxygen**

Turbidity is a term commonly used to describe the clarity (or conversely, the cloudiness) of water. Turbidity is related to the amount of suspended particulate matter in the water and is measured in nephelometric turbidity units (NTUs).

#### **3.1.2.1 Existing Conditions**

In the Lower Willamette River, average turbidity tends to be highest in fall and winter and under high flow conditions. USGS measures turbidity in Formazin Nephelometric Units [FNU], which are similar to NTUs) at the Morrison Bridge, just upstream of the Site (USGS 2016). During water year 2015 (from October 2014 to September 2015, monthly minimum and maximum FNU were as follows:

October: 0.9-8.1; November: 4.9-31; December: 6.4-82; January: 6.4-71; February: 4.3-77; March: 2.6-33; April: 1.4-13; May: 1.2-9; June: 0.9-9.8; July: 1.4-15; August: 0.7-13; September: 0.5-5.2 (USGS 2016). Based on these data, turbidity is expected to be relatively low during the in-water work window between July 1 and October.

Mean monthly dissolved oxygen (DO) levels (mg/L) measured at the same location during the same time period were as follows:

October: 9.32; November: 10.94; December: 12.36; January: 12.31; February: 11.82; March: 10.93; April: 10.44; May: 9.45; June: 8.61; July: 6.53; August: 8.13; September: 7.91 (USGS 2016). Based on these data, DO is expected to be relatively low during the in-water work window between July 1 and October 31.

DEQ maintains water quality monitoring sites throughout Oregon. The most recent trends in water quality were measured by the Oregon Water Quality Index for 1997 to 2006 (DEQ 2007). Two monitoring sites are located in the Lower Willamette River channel (DEQ 2007) at RM 7.0 (Southern Pacific Railroad Bridge) and upstream of the Site at RM 13.2 (Hawthorne Bridge). The index analyzes a defined set of water quality variables and produces a score describing general water quality. The water quality variables used include temperature, DO, biochemical oxygen demand, pH, total solids, ammonia and nitrate nitrogen, total phosphorous, and bacteria. The score produced to describe general water quality ranges from 10 (worst case) to 100 (ideal water quality). Water quality at RM 7.0 was classified as “fair” (minimum seasonal average index score of 82), while the water quality at RM 13.2 was classified as “good” (minimum seasonal average index score of 85). Overall, there were no significant trends noted from 1997 to 2006 at RM 7.0, while at RM 13.2, a decreasing score was noted (DEQ 2007).

Factors leading to a decreasing trend may include increased levels of point or non-point source activity and/or decreased flows (DEQ 2007). In addition, results from the temperature monitoring data indicate that 68 percent of the values at RM 7.0 and 61 percent of the values at RM 13.2 collected during the summer exceed the temperature water quality standard of 68°F.

### **3.1.2.2 No Action**

The No Action alternative will not result in impacts related to suspended particulates, turbidity, or DO.

### **3.1.2.3 Dredging**

Dredging and associated debris removal has the potential to result in significant adverse impacts related to turbidity and suspended particulate levels in the water column, particularly in near-bottom waters. Turbidity increases due to dredging are typically short term and localized in nature. Suspended sediment concentrations vary throughout the water column, with larger plumes typically occurring at the bottom, closer to the point of dredging. Even without suspended sediment controls, plume intensity decreases exponentially with movement away from the point of dredging both vertically and horizontally. In addition, increases in turbidity that result from dredging activities are typically of much less magnitude than increases caused by natural storm events (Nightingale and Simenstad 2001).

It is useful to consider studies of turbidity effects on juvenile salmonids since these fish are more sensitive than many other fish in the project area. Direct mortality from extremely high levels of suspended sediment has been documented at concentrations far exceeding those caused by typical dredging operations. Laboratory studies have consistently found that the 96-hour LC50 for juvenile salmonids occurs at levels above 6,000 milligrams per liter (mg/L) (Stober et al. 1981; Salo et al. 1980; LeGore and DesVoigne 1973). However, typical samples collected adjacent to dredge locations (within approximately 150 feet) contain suspended sediment concentrations between 50 and 150 mg/L (Palermo et al. 1990; Havis 1988; Salo et al. 1979).

Based on an evaluation of seven clamshell dredge operations, LaSalle (1988) determined that suspended sediment levels of less than 700 mg/L at the surface and less than 1,100 mg/L at the bottom would represent the upper limit concentration expected adjacent to the dredge source (within approximately 300 feet). This concentration would decrease rapidly with distance due to settling and mixing. Concentrations of this magnitude could occur at locations with fine silt or clay substrates. Much lower concentrations (50 to 150 mg/L at 150 feet) are expected at locations with coarser sediment such as the sands found throughout much of the Site.

Avoidance and minimization measures and best management practices (BMPs) described in Section 5 will be employed during dredging to minimize the potential for increased suspended sediment and turbidity levels. BMPs will include operational controls such as slowing the rate of dredge bucket descent and retrieval (increasing dredge cycle time).

Dredging operations will be monitored closely and managed carefully to minimize suspended sediment effects according to the applicable requirements for the proposed action, including any additional conditions to be established through agency consultation on ESA and to comply with the substantive requirements of CWA Section 401. Water quality monitoring will be conducted during dredging to avoid impacts related to exceedances of water quality criteria for turbidity, DO, and contaminants.

For the Terminal 4 Removal Action, EPA prepared a Water Quality Monitoring and Compliance Conditions Plan (WQMCCP) that defined appropriate points of compliance for water quality standards around dredging activities. The WQMCCP established the following points of compliance:

“For this project, the outer boundary of the water area a distance of 100 meters from the approximate center of the Removal Action activity is defined as the point of compliance for all field parameters other than turbidity. The compliance point for turbidity is 100 meters beyond the inner harbor line.”

Water quality parameters will typically be monitored at the compliance boundary of 100 meters, and activities will be suspended if levels exceed regulatory thresholds established for the proposed action. During remedial design, a WQMCCP would be developed on an SMA-specific basis to establish monitoring requirements and response actions.

Turbidity increases during dredging are expected to be limited, short-term, and localized and would be minimized during dredging with the implementation of BMPs and avoidance and minimization measures described in Section 5. However, there is potential for short-term localized impacts from elevated turbidity levels on fish and other aquatic species close to the dredge operations.

During dredging, suspension of anoxic sediment compounds may result in reduced DO in the water column in the immediate dredging plume area. Reductions in DO levels would have adverse impacts on aquatic species, particularly those occurring low in the water column. The reduction in DO levels beyond background is expected to be limited in extent and temporary in nature. Based on a review of four studies on the effects of dredging on DO levels, LaSalle (1988) showed little or no measurable reduction in DO around dredging operations. A decrease in DO during dredging would not be expected due to the following: (1) the relatively low levels of suspended material generated by dredging operations (less than 700 mg/L at the surface and less than 1,100 mg/L at the bottom of the water column); (2) counterbalancing factors in the river, such as tidal or current flushing; and (3) high sediment biological oxygen demand created by suspended sediment in the water column is not common (LaSalle 1988; Simenstad 1988) and is not expected to be an issue at the Site due to limited amounts of organic material expected to be present based on the results of sediment core sampling. In addition, compliance with water quality standards, including those to be established through agency consultation on ESA and to comply with the substantive requirements of CWA Section 401, would be achieved through operational BMPs and avoidance and minimization measures, including monitoring during dredging.

#### **3.1.2.4 Capping, In-Situ Treatment, and ENR**

The discharge of cap materials, in-situ treatment materials, and ENR sand, as well as the placement of the residuals cover layer in dredge areas (together defined as remediation fill materials) has the potential to result in significant adverse impacts related to turbidity and suspended particulate levels. In contrast to dredging, turbidity increases arising from discharge of remediation fill materials is expected to dissipate quickly due to the low level of organic material and larger grain sizes (e.g., sand/gravel) of the material to be used (NMFS 2005a). However, some localized short-term increases of turbidity above background river conditions could occur during placement of remediation fill materials. These localized turbidity/total suspended solids increases would be a short-term, minor adverse impact with implementation of the specific BMPs, avoidance, and minimization measures outlined in Section 5.

During in-place technology activities, material placed is not expected to result in a change in sediment oxygen demand (and resulting DO reduction) during transport through the water column. There may be minor resuspension at the point of impact of the placed materials; however, this condition is expected to be temporary and localized, and the activity would be monitored by water quality testing.

#### **3.1.2.5 CDF**

During construction of the CDF berm, the use of coarser material with low fine content for the berm fill will minimize turbidity and DO impacts associated with material placement. As with dredging operations, BMPs and avoidance and minimization measures described in Section 5 will be employed during construction of the CDF to minimize the potential for adverse effects on aquatic species. After the berm is built, the CDF area would be enclosed from the river such that there would be no in-water work and a very low potential for impacts related to turbidity or decreases in DO.

#### **3.1.2.6 Removal and Installation of Piles and Structures**

The removal of piles and, to a lesser extent, the replacement of piles and installation of structures could cause an increase in turbidity and decrease in DO. These adverse effects would be localized and short-term with implementation of the specific BMPs, avoidance, and minimization measures outlined in Section 5.

### **3.1.3 Water Quality Associated with Contaminants**

This section describes existing water quality and potential effects from the proposed action related to the potential for resuspension of contaminants during construction activities. Additionally there is a small chance that accidental spills from construction equipment could expose fish to contaminants. However, standard and appropriate material handling and containment procedures and BMPs, as described in Section 5, would be implemented to avoid or minimize impacts on aquatic species from accidental spills. Therefore, the following discussion focuses on potential effects from the resuspension of contaminants in sediments at the Site during the proposed action.

### 3.1.3.1 Existing Conditions

The Willamette River from Willamette Falls to its mouth on the Columbia River is identified by Oregon DEQ as water quality limited under CWA section 303(d) for temperature, fecal coliform, biological criteria (fish skeletal deformities), and toxics (mercury in fish tissue, dieldrin, aldrin, PCBs, DDT/ DDE, dioxin (2,3,7,8-TCDD), PAHs, manganese, iron, and pentachlorophenol) (DEQ 2012).

#### Toxics

The LWG conducted surface water investigations between November 2004 and March 2007 (LWG, as modified by EPA 2016). The BERA (Windward 2011) provides a comprehensive evaluation of potentially unacceptable risk to ecological receptors under conservative baseline exposure scenarios. For fish, including salmonids, effects from Lower Willamette River media were evaluated using tissue-residue, dietary, and surface water screening approaches. For juvenile salmonids, no whole body tissue sample concentrations were measured above toxicity reference values (TRVs). For a specific contaminant, the TRV provides a conservative chemical concentration estimate in a given exposure medium (or tissue) below which potentially unacceptable risks are not expected to occur. For other insectivorous fish (e.g., peamouth and sculpin), whole body sample concentrations were measured above TRVs for copper, lead, total PCBs, and total DDx, but hazard quotients (HQs) were low, which is an indication that the likelihood of potentially unacceptable risk is low.

Dietary evaluations indicated potentially unacceptable risk to juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and other insectivores from cadmium, copper, mercury, and TBT. Individual surface water samples exceeded chronic aquatic life water quality criteria/standards or benchmarks for zinc (in 1 of 167 samples, maximum HQ = 1.1); monobutyltin (in 1 of 167 samples, based on the TBT TRV, maximum HQ = 1.2); benzo(a)anthracene (in 2 of 245 samples, maximum HQ = 10); benzo(a)pyrene (BaP) (in 3 of 245 samples, maximum HQ = 14); naphthalene (in 10 of 268 samples, maximum HQ = 50); bis-2(ethylhexyl) phthalate (BEHP) (in 2 of 190 samples, maximum HQ = 2.3); total DDx (in 1 of 170 samples, maximum HQ = 1.8); ethylbenzene (in 1 of 23 samples, maximum HQ = 1.6); and trichloroethene (in 1 of 23 samples, maximum HQ = 4.1). All exceedance frequencies were less than 5 percent. Except for the PAHs, which had HQs ranging from 10 to 50, the magnitude of HQs was low, with the maximum only slightly exceeding 1.0, and the exceedances were not temporally or spatially consistent. No chemicals exceeded aquatic life criteria based on an SMA-wide average water concentration.

In addition, public and private outfalls are located on both shores of the river within the Site. These outfalls have historically discharged stormwater, municipal waste (both historically through direct sewage discharges and more recently through combined sewer overflows, most of which have now been eliminated), and industrial wastewater to the Site from numerous drainage basins that have a variety of land uses and facilities (LWG, as modified by EPA 2016). Stormwater inputs, along with other known external source loads, including watershed/upstream, groundwater, and process water discharges (i.e.,

National Pollutant Discharge Elimination System [NPDES] permitted discharges), represent a significant source of contaminants (particularly for total PCBs) within the Site.

In addition to areas adjacent to the Site, land uses in the Willamette Basin upstream of the Site, such as agriculture, industry, transportation, and residential areas, historically and currently discharge municipal, agricultural, and industrial wastewater and stormwater directly to the Willamette River and indirectly discharge through overland, overwater, and groundwater pathways, thereby contributing to chemical contamination of sediments within the Site and to nutrient loading and oxygen depletion in the surface water. Although private industries and municipalities within the river watershed began installing waste control systems beginning in the 1950s, the legacy of past waste management practices remains in the river bottom sediments (LWG, as modified by EPA 2016).

Upstream concentrations of chemicals in the surface water entering the Site already exceed one or more water quality standards, including Oregon and federal water quality standards/criteria for fish consumption, Oregon and federal freshwater chronic aquatic life water quality standards/criteria, and maximum contaminant levels (MCLs). Upstream surface water background levels of arsenic, dieldrin, total PCBs, total PAHs, 4'-DDT, sum DDT, and 2,3,7,8-TCDD exceeded Oregon water quality standards for fish consumption. Upstream surface water background levels of mercury exceeded Oregon chronic aquatic life water quality standards.

### **Contaminated Sediment Inputs to Surface Water Quality**

Lower Willamette River sediment is a known contaminant source that can potentially impact surface water quality through diffusion and advection of pore water containing dissolved chemicals. Mechanical disturbances to sediment from propeller wash or in-water construction, as well as natural erosion and transport, may also result in releases to the water column.

The most ecologically significant COCs (also known as “focused” COCs) for the Site are PAHs, PCBs, DDx compounds, and dioxins/furans, which are all organic compounds with the potential to become resuspended during mechanical sediment disturbance within the Site. However, the BERA identified a total of 93 COCs (as individual contaminants, sums, or totals) as potentially posing unacceptable ecological risk.

Exposure to dissolved aqueous phase organic compounds can potentially result in adverse effects to fish, including impacts on survival, growth, and reproduction. The BERA found that relatively infrequent and low magnitude exceedances of water TRVs by surface water concentrations of organic compounds in the Site are not indicative of ecologically significant risk to fish. In contrast, exposure to organic contaminants in fish tissues poses potentially unacceptable risks to wildlife and people. In addition, area-specific sediment concentrations of six metals (cadmium, chromium, copper, lead, mercury, and silver) were identified as potentially contributing to benthic toxicity. Desorption of metals from suspended sediments potentially occurs within the Site during sediment disturbance.

### 3.1.3.2 No Action

The No Action alternative will not result in changes to water quality from existing conditions. The existing degraded condition would persist under the No Action alternative.

### 3.1.3.3 Dredging

Physical disruption of the contaminated sediments during dredging is necessary to implement the proposed action, which could cause a temporary increase in dissolved and particulate phase concentrations of some chemicals in the vicinity of dredging activities resulting from resuspension of contaminated sediments, desorption of the contaminants from sediment particles to the water column, and release of contaminated pore water into surface water. This effect is expected to be most observable when dredging areas with the highest contaminant concentrations in sediments and less observable in areas with relatively low sediment contaminant concentrations. If aquatic species are present in the portion of the action area where dredging is occurring, they could potentially be at risk of exposure. Whether that exposure causes detrimental biological effects depends on the concentration of the chemicals in the water and the duration of exposure. If contaminant concentrations are great enough or if exposure persists over a long period of time, the potential risk of adverse effects or bioaccumulation of some chemicals increases.

Dredging is anticipated to result in impacts on water quality from resuspension of contaminants into the water column. The locations causing the most exceedances of water quality criteria generally would be in areas where the highest contaminant concentrations are being dredged and in backwater quiescent areas. Short-term (during construction) increases in water column concentrations is expected to occur intermittently during the duration of the dredging and dissipate when dredging ceases.

Based on the BERA, the potential acute exposure of contaminants during dredging at the Site is likely associated with soluble compounds such as benzene, naphthalene, and chlorobenzene in addition to PAHs, PCBs, and DDx compounds in a few potential dredging areas within the Site and their immediate vicinity. The vast majority of resuspended sediment settles close to the dredge within 1 hour, and only a small fraction takes longer to resettle (Anchor Environmental LLC 2003). Therefore, a majority of the contaminants in the particulate fraction resuspended by dredging may not have time to desorb before they resettle to the sediment bed. If ingested, the particulate bound portion of chemicals can also be toxic or contribute to bioaccumulation of chemicals in an organism's tissue.

The avoidance and minimization measures, including BMPs described in Section 5 would avoid or reduce potential impacts on aquatic species from exposure to contaminants released to the water column during dredging. These measures would include water quality monitoring to confirm that water quality standards are being achieved during the remedial activities that disturb the sediment surface. Additional contaminant dispersion modeling may be required during remedial design for SMAs with higher levels of contamination to determine potential exposure levels and develop the procedures



required to minimize the release of contaminants to the water column.

The timeline for the potential for exposure to resuspended chemical contaminants related to dredging within the Site is expected to occur intermittently during the 4 month in-water work window. Dredging is assumed to occur 24 hours per day and 6 days per week. Based on estimated dredge volumes and production rates and estimated cap material volumes and application rates, in-water construction activities for the proposed action are estimated to take between 4 to 5 years to complete.

In summary, although there may be a potential risk to aquatic species from short-term exposure to resuspended chemical contaminants within the Site, the long-term sediment quality improvements associated with the proposed action will lead to benefits for aquatic species by reducing exposure to a known source of chemical contamination.

#### **3.1.3.4 Capping, In-Situ Treatment, and ENR**

During placement of remediation fill materials, there would be minor impacts on water quality from disturbance of the sediment bed containing contaminants. These water quality effects are anticipated to be of short duration, lasting a few hours, and limited to the immediate vicinity of the work area with implementation of the avoidance and minimization measures and BMPs described in Section 5. Water quality will be monitored during all remedial actions consistent with water quality standards and monitoring requirements set forth for the proposed action.

As with dredging, the capping, in-situ treatment, and ENR activities will result in overall long-term benefits from substantial decreases in exposure to contaminants in sediment, porewater, and surface water.

#### **3.1.3.5 CDF**

During construction of the CDF berm, BMPs and avoidance and minimization measures described in Section 5 will be employed to avoid and minimize the potential for adverse effects on aquatic species from resuspension of contaminants in sediment.

The use of a CDF to contain contaminated sediments will not result in long-term impacts on surface water quality, as the CDF will be designed to meet water quality standards in perpetuity, including chronic ambient water quality criteria, fish consumption criteria, and drinking water criteria in consideration of ambient background conditions. Once construction of the CDF berm is complete, the CDF will be fully enclosed from the river, limiting potential water quality impacts during filling. Potential release of contaminated sediments during barge transport to the CDF, or to trucks for access to the CDF from the shore, would be minimized according to BMPs outlined in Section 5.

Construction of the CDF berm will include a weir and outfall structure that will be used to drain water from the CDF as it is being filled with sediment. This structure will consist of a pipe and a weir structure through which effluent, when necessary, will outlet at the waterward face of the containment berm into the Willamette River. During filling, as

water within the CDF begins to approach a level at which discharge would be necessary, filling would be slowed or stopped to prevent overflow. If discharge is necessary, water quality within the CDF will be sampled and characterized prior to discharge to confirm that water quality criteria will be achieved at the point of discharge from the CDF, which will be established through agency consultation on ESA and to comply with the substantive requirements of CWA Section 401. A detailed water quality monitoring plan similar to that being developed with the Port of Portland would be required.

The CDF will be designed and constructed to prevent release of contaminants and long-term impacts on water quality. Long-term monitoring will include evaluating physical stability of the CDF berm during and following high flow and flood events and groundwater quality monitoring of the CDF and berm. To facilitate groundwater monitoring of the CDF and berm, groundwater wells will be installed during final CDF capping activities.

#### **3.1.3.6 Removal and Installation of Piles and Structures**

The removal of piles and the replacement of piles and installation of structures could cause contaminants in sediments to be resuspended. This impact would be localized and short-term with implementation of the specific BMPs, avoidance, and minimization measures outlined in Section 5.

### **3.1.4 Current Patterns and Water Circulation and Normal Water Fluctuations**

This section describes existing conditions at the Site with respect to currents, water circulation, and normal water fluctuations, including tidal influence, and potential effects to these conditions from the proposed action.

#### **3.1.4.1 Existing Conditions**

Today, the Willamette River is noticeably different from the river prior to industrial development that commenced in the mid to late 18th century. Historically, the Willamette River was wider, with more sand bars and shoals, and flow volumes were subject to greater fluctuation. The main river now has been redirected and channelized, several lakes and wetlands in the lower floodplain have been filled, and agricultural lands converted to urban or industrial areas. The end result is a river that is deeper and narrower than it was historically, with higher banks that prevent the river from expanding during high-flow events (LWG, as modified by EPA 2016).

River currents and water circulation in the Lower Willamette River in the vicinity of the Site are influenced by hydrologic conditions in both the Willamette and Columbia rivers and are further affected by the operations of dams. With each major storm, the USACE is responsible for controlling the amount of water retained and then released from the dams at the end of the storm to dampen hydrographic peaks and valleys. The effect of the 13 dams on the Willamette River and its tributaries has generally been to reduce the spring high water flows with retention and storage of water through the system-wide management of reservoirs.

Higher current speeds occur in the deeper portions of the river channel, and lower speeds occur in the shallow nearshore areas, regardless of flow direction. In the deeper, offshore areas of the Lower Willamette River, such as within the federal navigation channel and adjacent areas in the mainstem deeper than about -20 feet NAVD88, the movement of water appears to be controlled primarily by the physical shape of the river, both the cross-sectional area and anthropogenic alterations such as borrow pits, dredged areas, and structures (e.g., bridge footings) (LWG, as modified by EPA 2016).

Low water typically occurs between September and early November prior to the initiation of the winter rains (U.S. Geological Survey 2016). High water events can occur in the winter and from late May through June; a distinct and persistent period of relatively high water levels occurs when Willamette River flow into the Columbia is slowed by high-water stage/flow in the Columbia River during the spring freshet in the much larger Columbia River Basin. The Columbia River flow drops as the summer progresses, and this effect is diminished. During the winter, high seasonal flows on the Willamette River can be allowed to pass through to the Columbia River, which may have diminished flows due to retention at dams.

The lower reach of the Willamette River from RM 0 to approximately RM 26.5 is a wide, shallow, slow moving segment that is tidally influenced, with tidal reversals occurring during low flow periods as far upstream as RM 15. Currents generally flow downstream although reverse or upstream flows occur when the Willamette River flow is low and the tide is in flood stages. The tidal range varies throughout the year; a tidal fluctuation of approximately 4 feet was used for evaluations conducted during the RI (LWG, as modified by EPA 2016).

#### **3.1.4.2 No Action**

The No Action alternative will not result in impacts on current patterns, water circulation, or normal water fluctuations.

#### **3.1.4.3 Dredging**

Dredging may cause some temporary, localized changes in currents and water circulation due to the presence of the vessels and equipment required to conduct the activity. These potential temporary impacts are anticipated to be negligible because they will be insignificant localized impacts within the Lower Willamette River. Following dredging in nearshore areas, elevations would be restored to pre-dredge conditions. Therefore, impacts on currents, water circulation, and normal water fluctuations are anticipated to be negligible.

#### **3.1.4.4 Capping, In-Situ Treatment, and ENR**

As with dredging, the presence of the vessels and equipment for placement of remediation fill materials may cause some temporary, localized changes in currents and water circulation; however, these potential effects would be temporary and negligible. The placement of remediation fill materials in shallow areas would require dredging of an equivalent cap thickness (maximum of 3 feet) prior to placement to allow for a net zero

bathymetry change and avoid loss of shallow water habitat. Therefore, impacts on currents, water circulation, and normal water fluctuations are anticipated to be negligible.

#### **3.1.4.5 CDF**

Hydrologic Engineering Center (HEC) 2 modeling was conducted as part of the CDF feasibility analysis to assess the potential impacts of the proposed CDF at Terminal 4 on Willamette River flood stage. The preliminary assessment of potential impacts on the Willamette River showed that the rise in flood stage at and just upstream of Terminal 4 would be negligible and would meet federal and City of Portland criteria (BBL, Inc. 2005).

#### **3.1.4.6 Removal and Installation of Piles and Structures**

The removal of piles and the replacement of piles and installation of structures could cause very localized changes in currents and water circulation; however, these potential effects would be negligible.

### **3.2 POTENTIAL IMPACTS ON BIOLOGICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM**

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This section describes existing conditions of, and potential impacts on, the biological characteristics of the aquatic ecosystem in the project area. Potential impacts are described for threatened and endangered species based on information presented in the Programmatic BA. The section also evaluates impacts on the aquatic food web, including benthic invertebrates, non-listed fish species, such as smallmouth bass and others caught by anglers, and wildlife.

#### **3.2.1 Threatened and Endangered Species**

As described in the Programmatic BA, several listed species occur within the project area, which includes both the Lower Willamette River and the Lower Columbia River. The listed species that have the potential to occur in the project area and be impacted by the proposed action are listed in **Table 3-1**.

Some of the avoidance and minimization measures and BMPs described in Section 5 are specific to the protection of listed species. For instance, the in-water work window (between July 1 and October 31) is the time when listed fish are expected either to not be present or to be present in very low numbers in the action area. However, most of the measures in Section 5 would also avoid and minimize effects on other aquatic species and wildlife in the project area.

##### **3.2.1.1 Existing Conditions**

A detailed description of existing conditions related to habitat for listed species (also known as the environmental baseline) is provided in the Programmatic BA. Existing conditions in the Lower Willamette River related to substrate and shoreline conditions are described in Section 3.1.1.1 above; water quality is described in Sections 3.1.2.1 and 3.1.3.1; and water quantity is described in Section 3.1.4.1.

Other factors important for listed species in the project area include floodplain connectivity, natural cover, and habitat access and refugia. In general, these characteristics are degraded in the Lower Willamette River due to the filling, channelizing, and shoreline modifications that have occurred during development and industrialization. The river has been disconnected from its floodplain, and there are few areas with mature, high quality riparian habitat throughout the Site. The typical bank condition is steep with poor substrate, which results in little to no emergent or submerged vegetation at the Site.

Although the natural cover condition within the Site is generally degraded, there are SMA-specific exceptions. Habitat access and refugia in the Lower Willamette River have also been significantly impacted since the late 1800s, with approximately 79 percent of the shallow water habitat converted to deep water habitat within that time period.

### **3.2.1.2 No Action**

The No Action alternative will not result in impacts on listed species. Contaminants would continue to pose unacceptable risk to listed species through impacts on benthic invertebrates and other prey species and through direct impacts on listed species.

### **3.2.1.3 Remedial Activities including Dredging, Capping, In-Situ Treatment, ENR, and Removal and Installation of Piles and Structures**

As described in Section 3.1.2.3 and Section 3.1.3.3, remedial activities, particularly dredging, have the potential to result in adverse impacts related to turbidity and resuspension of contaminants. These effects would be relatively short-term and localized with the implementation of measures described in Section 5. However, there could be impacts on listed species, specifically juvenile salmon that could be present during in-water work. In addition, while elevation, slope, and substrate would be restored in shallow areas to the extent possible, there would be long-term adverse impacts in some areas, as follows:

- **Natural Cover:** While very limited in the action area, some river bank areas may support natural riparian cover that would be removed or disturbed during remedial activities, and it may not be possible to restore natural cover on site in all of the areas where it is disturbed.
- **Substrate and Forage:** Some areas of existing sand or gravel may be permanently lost with the placement of engineered caps that use riprap armor as a surface layer and where placement of beach mix as a top layer is not possible.
- **Shoreline Armoring and Slope:** As described above, some armoring would occur in shoreline areas, and it may not be possible to restore ideal slopes.
- **Habitat Access and Refugia:** In some areas, dredging may be required to a depth such that shallow water would be converted to deep water and/or there would be loss of shallow water habitat complexity, reducing the amount of shallow water

habitat and refugia available.

Compensatory mitigation would be required to address these impacts, as described in Section 6.

#### **3.2.1.4 CDF**

At the proposed Terminal 4 CDF location, approximately 15 acres of aquatic habitat would be converted to upland, resulting in permanent loss of aquatic habitat. Of the 15 total acres of aquatic habitat lost, approximately 3 acres, or about 20 percent of the total aquatic habitat, would be shallow water habitat (less than 20-feet deep). This would be an adverse impact to listed species, and compensatory mitigation would be required, as described in Section 6.

#### **3.2.1.5 Entrainment**

In-water work will take place during the in-water work windows, and avoidance and minimization measures and BMPs will be implemented to reduce the potential for fish to be entrained or come in contact with construction equipment. In general, fish that are present within work areas during construction would be expected to avoid or rapidly move away from construction areas and other locations of active disturbance. For other dredging projects, NMFS has found that injury or death to listed salmonids as a consequence of entrainment is expected to be minimal based on timing restrictions for shallow water work, operational BMPs, and the fact that salmonids can usually avoid dredging activities (NMFS 2005b).

Silt curtains and sheet piling may be used in localized areas to prevent migration of highly contaminated sediment during dredging or during disposal operations. Entrainment during these activities would be avoided with the implementation of the fish capture and removal measures within the silt curtain or sheet piling containment structures in coordination with NMFS and other agencies, as appropriate, as described in Section 5.

During construction of a CDF, entrainment of fish behind the isolation berm or structure is also possible. To avoid trapping any fish, fish would be removed or excluded from the work area. The strategy for fish removal will be determined during remedial design but is likely to be conducted with the use of electrofishing, beach seining, purse seining, and fyke nets. These removal activities could lead to injuries to listed fish species. However, the berm construction would take place during the in-water work window to minimize the number of listed species that may be in the work area. In addition, fish capture and removal measures would be implemented prior to these activities. These measures are described in Section 5.

#### **3.2.1.6 Noise**

Overall, the activities associated with the proposed action, except piling removal and installation, are not expected to create a noise impact on aquatic species. Construction noise is not likely to increase noise levels above ambient levels in water and out of water.

However, in-water noise could be elevated as a result of pile installation activities. Pile driving activities are proposed in the Lower Willamette River, and salmonids could potentially be present during the installation activity. It is assumed that pile driving operations will use the vibratory hammer method. If impact pile driving is proposed, it will be evaluated on an SMA-specific basis during remedial design.

Vibratory pile driving produces noise levels that are less than those generated during impact pile driving (Washington State Department of Transportation [WSDOT] 2015) under similar conditions. Noise from the vibratory hammer installation of piles has not been found to cause barotraumas to fish (physical injury documented to result from impact pile driving) because the vibratory pile extractor noise does not have the rapid-rise peak pressure that is characteristic of impact pile driving (WSDOT 2015). As such, no measurable effects on salmonids are expected to result from vibratory pile removal or installation activities.

To further minimize any potential for impacts resulting from vibratory pile removal and driving activities, pile driving will be conducted within the in-water work window approved for the protection of salmon such that listed salmon would not be present in appreciable numbers at any given time. Additional impact avoidance and minimization measures would be implemented, as outlined in Section 5. Therefore, adverse effects from pile driving activities would be reduced to the maximum extent possible.

### **3.2.1.7 Lamprey Ammocoetes**

Although Pacific lamprey are not an ESA-listed species, they are designated as a species of concern by USFWS due to their cultural significance and declining populations. Pacific lamprey ammocoetes may be present in sediments year-round in the project area, particularly in depositional areas such as in low velocity pools and stream margins. Ammocoetes are particularly vulnerable to remedial activities, such as dredging and capping that would be implemented under the proposed action.

USFWS has recommended BMPs be implemented prior to dredging, capping, and other sediment disturbance to avoid and minimize impacts on lamprey ammocoetes in accordance with a Conservation Agreement between local tribes, states, federal agencies, non-governmental organizations, and other stakeholders (USFWS 2012). As described in Section 5, these recommendations include electrofishing surveys for the presence of lamprey ammocoetes prior to construction.

## **3.2.2 Aquatic Food Web**

This section describes the existing conditions at the Site with respect to the aquatic food web, primarily focused on benthic and water column invertebrates, which represent the primary food source for many fish and aquatic species in the project area. Potential impacts on these communities are then discussed.

### **3.2.2.1 Existing Conditions**

- Various aquatic invertebrate surveys, along with a study of juvenile salmonid

diets, have been conducted in the Lower Willamette River, as summarized below:

- Ward et al. (1988) conducted benthic surveys in and around Portland Harbor and found the dominant species to be oligochaetes and cladocerans. The study also commonly found amphipods and chironomids.
- Windward Environmental conducted a survey of the benthic and epibenthic community within the Site and found an abundance of oligochaetes, chironomids, and the amphipod *Corophium* spp (LWG, as modified by EPA 2016).
- A study of macroinvertebrates and zooplankton in the Lower Willamette River using a variety of gear types found an abundance of cladocerans (bosminids and *Daphnia*), copepods, aquatic insects (including chironomids), and oligochaetes (Friesen et al. 2004).
- In Friesen 2005 study, the species diversity in various habitat types was investigated. Overall, the study found few differences in the proportional distribution of major taxa groups among habitat and concluded that the Lower Willamette River is a generally homogenous community (Friesen 2005). Despite this finding, there were general trends that were identified: beaches tended to have relatively high species diversity, whereas seawalls were found to have relatively low densities and diversity. Aquatic insects appeared to prefer rock outcrops and floating structures. Rock riprap sites had very high densities of invertebrates and relatively high diversity (Friesen 2005).
- A 2009 study by SWCA Environmental Consultants (SWCA) conducted benthic macroinvertebrate sampling in downtown Portland. They found an invertebrate community with a similar composition as found in other studies. Specifically, they identified a high abundance of oligochaetes, chironomids, the amphipod *Americorophium* sp, the polychaete *Manayunkia speciosa*, and the clam *Corbicula fluminea*. Salmonids are known to feed on chironomids and amphipods. These species were found at depths ranging from 11 to 79 feet and in substrates ranging from medium silt to medium gravel (SWCA 2009).
- A 2004 salmonid diet study identified the water column invertebrate *Daphnia* sp. as the most abundant species in the stomachs of juvenile Chinook (larger than 99 mm) and coho by both abundance and wet weight in the Lower Willamette River throughout a majority of the year. These water column species are also in high abundance in the Lower Willamette River. The study also found the amphipod *Corophium* sp. and both aquatic and terrestrial insects to be a common component of salmonid diets (Vile et al. 2004).

These studies documented both water column and benthic salmonid prey items available in the Lower Willamette River across most habitat types, including riprap. The cladoceran *Daphnia* was found in abundance throughout the Lower Willamette River although Bosminidae (another cladoceran group) was found to be more abundant (Friesen



et al. 2004).

The distribution of invertebrate communities varies across the Site. In general, sheltered areas away from anthropogenic disturbance should support well-developed infaunal invertebrate communities that are characteristic of large river systems. Conversely, exposed nearshore areas, particularly around berths, docks, and boat ramps, likely have limited benthic communities due to the greater physical disturbance in these areas. Tidal and seasonal water level variability and nearshore disturbances (e.g., boat wakes) have a much larger effect in shallow water than they do in deeper water. The hard surfaces of the developed shoreline provide habitat for an epibenthic community. The navigation channel habitat is subject to hydrodynamic forces, the impacts of navigation, natural sediment deposition, bed load transport/erosion, and periodic navigational dredging. These forces vary spatially, resulting in the presence of both relatively stable and unstable sedimentary environments and patchy infaunal and epibenthic communities (LWG, as modified by EPA 2016).

#### **3.2.2.2 No Action**

The No Action alternative will not result in impacts on the aquatic food web. Contaminants would continue to pose unacceptable risk to benthic invertebrates and fish.

#### **3.2.2.3 Remedial Activities including Dredging, Capping, In-Situ Treatment, ENR, and Removal and Installation of Piles and Structures**

Remedial activities that disturb the sediment surface will temporarily remove the biologically active zone and associated benthic communities. Recovery times for benthic communities following remedial activities are expected to be on the order of months. The Biological Opinion (BO) for the Lower Columbia River Channel Improvement Project indicates that benthic organisms recolonize dredge locations rapidly (NMFS 2005a). A study completed in the Columbia River estuary indicates that recolonization usually occurs between a few and several months (McCabe et al. 1996, McCabe et al. 1998). NMFS found that maintenance dredging in the navigation channel, as well as the side channels, is likely to temporarily reduce the suitability of the sediment for recolonization by copepods (*C. salmonis*) by reducing the organic matter content of the sediments and altering sediment particle size; therefore, some prey species will be lost. According to the NMFS BO, “these changes in prey availability are unlikely to be of a magnitude or extent that would appreciably diminish forage resources in the action area” (NMFS 2005a). Benthic communities are expected to recover similarly for areas where in-place treatment material is placed.

Following dredging, a 12-inch thick sand layer will be placed over the dredged area to cover the exposed surface and isolate any dredge residuals and remaining contaminated sediment. Most caps, as well as placement of in-situ treatment and ENR material, would also consist of a top layer of sand. In addition, beach mix, consisting of rounded gravel typically 2.5 inches or less, would be applied to the uppermost layer of all caps and dredge leave surfaces in nearshore areas. This layer would provide appropriate substrate habitat for colonization by benthic organisms. Beach mix would not be applied to leave

surfaces consisting of sand unless required due to changes in hydrodynamic conditions following remedial activities.

In many areas, the physical and chemical improvement in substrate type as a result of the removal of contamination and placement of the dredge residuals cover layer may promote a more productive benthic community through recolonization on uncontaminated material. However, the placement of armor as a surface layer on top of an existing sand or gravel beach substrate in shallow water areas would lead to a long-term impact to benthic communities that were established in the sand/gravel substrate. Re-deposition of fine-grained material in capped and armored areas is anticipated to occur over time, making the armored areas similar in surface grain size to non-armored areas and reducing the adverse impact. However, in areas where armoring is required, adverse impacts would require compensatory mitigation, as described in Section 6.

Overall, remedial activities will benefit the aquatic ecosystem by reducing exposure to contaminants in sediment, porewater, and surface water. The most significant predicted improvement based on the food web model (see FS Appendix H) would be the reduction in fish and invertebrate tissue of PCBs, dioxin/furans, DDx, and other compounds. This would indirectly result in a minimization of exposure and potential adverse effects to higher trophic level organisms (avian and mammalian species, including people).

#### **3.2.2.4 Use of Activated Carbon**

Several studies have examined the potential adverse effects to aquatic species, especially benthic invertebrates, from the use of activated carbon (AC) in capping and in-situ treatment materials (Cho et al 2009; Ghosh et al 2011; Beckingham et al 2013; Jonker and van Mourik 2014). Adverse effects to benthic invertebrates or other aquatic species from the use of 5 percent or less AC in capping or in-situ treatment materials appear to be limited. AC works primarily by retarding contaminant transport through the cap and acting as a barrier between the contaminated sediment and the new benthic layer, thus, preventing exposure of the benthic and pelagic communities to the contaminants. This would be a significant benefit to listed salmonid and other aquatic species in the Lower Willamette River.

### **3.2.3 Wildlife**

This section describes the common wildlife species and limited habitat in the project area. Potential impacts on these species are also discussed.

#### **3.2.3.1 Existing Conditions**

A diverse group of birds and a small number of aquatic or aquatic-dependent mammals are known to occupy habitat areas in the Lower Willamette River. Birds that use the Lower Willamette River represent various feeding guilds and include many migratory and resident species. Resident birds, such as bald eagle, Canada goose, mallard, spotted sandpiper, great blue heron, and many others, are found in the project area. Mammals that use the Lower Willamette River include mink, river otter, beaver, muskrat, raccoon, and California sea lion. Habitat to support amphibians is limited within the Site as most

local species prefer undisturbed areas that offer seasonal wetlands with emergent plants and shallow waters. Similarly, most local reptile species prefer wet vegetated upland habitats that are very limited at the Site. The benthic invertebrate community at the Site is dominated by worms, midge (fly) larvae, amphipods (small shrimp-like animals), mayfly larvae, caddisfly larvae, flatworms, crayfish, and the invasive Asiatic clam (*Corbicula fluminea*) (effects on the benthic community are described in Section 3.2.2).

In addition, **Table 3-2** identifies the state sensitive wildlife species for the project area's ecoregion. It should be noted that suitable habitat for most of these sensitive species is not available in the project area.

As described in Section 3.2.1.1, habitat for common wildlife species is limited to remnant, fragmented riparian forest patches that remain along some portion of the river banks. Approximately 4,600 linear feet (17 percent) of shoreline with natural cover is located within active remediation areas where there is a potential for an impact to occur if a remedial design extends to the riparian area. These habitat patches serve as connectivity corridors for various species of aquatic and shorebird species and semi-aquatic mammals to connect to larger areas of wildlife habitat within the proposed action area such as Harborton Wetlands, Oaks Bottom, Forest Park, and Powers Marine Park (City of Portland 2009).

In addition, shallow water areas and adjacent shorelines that support some riparian or emergent vegetation, woody debris, and other features may provide food and refuge. As a result, species that prefer slower water velocities, foraging opportunities, and cover and refugia provided by shallow water habitat, such as otter, mink, and juvenile salmonids, are confined to narrow strips of shallow water habitat between the shoreline and navigational channel.

### **3.2.3.2 No Action**

The No Action alternative would have no impact on wildlife. Contaminants would continue to pose unacceptable risk to benthic invertebrates and fish. In addition, the BERA identified existing risks to wildlife, including spotted sandpiper, hooded merganser, bald eagle, osprey, mink, and river otter, primarily through ingestion of contaminated prey.

### **3.2.3.3 Remedial Activities including Dredging, Capping, In-Situ Treatment, ENR, and Removal and Installation of Piles and Structures**

#### **Water Quality**

Potential impacts related to turbidity and water quality resulting from remedial activities will have a negligible impact on other wildlife. Turbidity and resuspended sediments would likely result in wildlife avoidance of construction areas during implementation of the remedial activity. This impact would be localized and temporary in nature, and access to specific locations in the Site will be affected for only a portion of the in-water work window.

### **Noise and Human Disturbance**

During remedial activities, noise, vibration, and increased presence of equipment and human activity would disrupt wildlife that may be present in habitats along the shoreline. This would likely cause birds and other wildlife to relocate to adjacent habitats during construction activities. It is anticipated that this disturbance would not be significantly increased over current conditions in the Site due to the high degree of activity already present in this industrial harbor setting.

### **Contact with Construction Equipment**

Wildlife that are present within work areas during construction would be expected to avoid or rapidly move away from construction areas and other locations of active disturbance. Avoidance and minimization measures described in Section 5 would avoid or reduce the potential for wildlife to come in contact with construction equipment.

### **Substrate and Forage**

Waterfowl and other wildlife species forage on aquatic invertebrates and vegetation. Sand and/or beach mix used as residual cover will provide a suitable substrate that will be quickly colonized by benthic invertebrates (within several months), and compensatory mitigation would replace lost habitat and forage area, as described in Section 6. Water column invertebrates, such as *Daphnia* sp., are expected throughout the water column in many areas of the Site, and impacts resulting from short-term reduced water quality are not expected to be at a level that would affect the abundance of these ubiquitous prey items. Overall, reductions in contaminant exposure will provide an improvement over existing conditions for the aquatic food web and, therefore, to other wildlife.

### **Riparian Habitat**

Remediation of some river bank areas with known contamination would occur during the proposed action. While most of these river bank areas are highly industrial and consist of developed areas or steep, armored slopes with blackberry and other non-native vegetation, some areas may support natural riparian cover that would be removed or disturbed during remedial activities. Following remedial activities, natural cover in these areas would be restored to the maximum extent possible; however, this may not be possible in some areas with steep slopes, and compensatory mitigation would be required, as described in Section 6.

During remedial design, SMA-specific projects would be required to perform habitat assessments prior to construction to identify the presence of sensitive wildlife species and comply with restrictions to avoid or minimize impacts. This would include restrictions on removal or disturbance of riparian vegetation to avoid impacts on nesting migratory birds.

#### **3.2.3.4 CDF**

At the proposed Terminal 4 CDF location, approximately 15 acres of aquatic habitat would be converted to upland, resulting in permanent loss of aquatic habitat. Of the 14 total acres of aquatic habitat lost, approximately 3 acres, or about 20 percent of the total

aquatic habitat, would be shallow water habitat (less than 20-feet deep). This would be an adverse impact on wildlife species that may utilize this shallow water habitat. In addition, the construction and use of a CDF would reduce the amount of natural cover if the footprint would cover riparian areas. Compensatory mitigation would be required to address this impact, as described in Section 6.

### **3.3 POTENTIAL IMPACTS ON SPECIAL AQUATIC SITES**

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This section describes existing conditions and potential impacts on special aquatic sites.

#### **3.3.1 Sanctuaries and Refuges**

This section describes existing sanctuaries, refuges, and areas designated by the City of Portland as “Special Habitat Sites” and discusses potential impacts on these areas from the proposed action.

##### **3.3.1.1 Existing Conditions**

Sanctuaries and refuges are defined in 40 CFR §230.40(a) as “areas designated under State and Federal laws or local ordinances to be managed principally for the preservation and use of fish and wildlife resources.” Three areas within close proximity to the Site are managed principally for the preservation and use of fish and wildlife:

- Oaks Bottom Wildlife Refuge
- Smith and Bybee Wetlands Natural Area
- Sauvie Island Wildlife Area

These three areas meet the federal definition of sanctuaries and refuges; however, the Oaks Bottom Wildlife Refuge is located 3 miles upstream from the Site and would not be directly affected by any of the proposed alternatives (**Figure 3-4**).

The Sauvie Island Wildlife Area is an approximately 11,500 acre state-owned game management area located west of the Site at the north end of Sauvie Island, at approximately RM 100 of the Columbia River just downstream of the confluence with the Willamette River (Oregon Department of Fish and Wildlife [ODFW] 2012). It was established in 1947 with the primary objectives of protecting and improving waterfowl habitat and providing a public hunting area (ODFW 2012). Sturgeon Lake, at 3,000 acres, comprises a large portion of the wildlife area and provides habitat to waterfowl and a number of warm water fish, including catfish, perch, and crappie. The lake also provides important off-channel foraging habitat for migrating juvenile salmonids. The management area includes water access for fishing and a boat ramp for small boat access. Trails are maintained throughout the management area for wildlife viewing and limited hunting activities.

The Smith and Bybee Wetlands Natural Area is an approximately 2,000-acre nature reserve characterized by an extensive network of sloughs, wetlands, and forests. The

natural area is located 2 miles downstream of the Study Area on the east side of the Lower Willamette River at the confluence with the Columbia River at RM 103 of the Columbia River. This area is managed by the Metro regional government as a natural area according to the terms of the Comprehensive Smith and Bybee Wetlands Natural Resource Management Plan (Oregon Metro Regional Government 2013). This area is also recognized by the Audubon society of Portland as a Priority Habitat Area. The Smith and Bybee Wetlands Natural Area is one of the largest protected wetlands in the United States (Portland Parks and Recreation [PP&R] 2011). It provides habitat to beaver, river otter, black-tailed deer, osprey, bald eagles, and Western painted turtles. The reserve includes a canoe launch and contains an extensive trail system for wildlife viewing.

In addition to the wildlife refuges listed above, there are a number of locations within the Site that have been identified in the City of Portland Natural Resource Inventory as “Special Habitat Sites” (City of Portland 2009), as shown in **Figure 3-4**:

- NW Willamette River Forested Wetland (RM 2.0)
- West Wye/I-5 Power Line Mitigation Site (RM 2.8)
- Harborton Forest and Wetlands Complex (RM 2.8)
- Willamette Cove Bottomland (RM 6.8)
- Swan Island Lagoon Beach and Wapato Wetland (RM 9.0)

### **3.3.1.2 No Action**

The No Action alternative would not result in impacts on sanctuaries or refuges.

### **3.3.1.3 Remedial Activities including Dredging, Capping, In-Situ Treatment, ENR, and Removal and Installation of Piles and Structures**

The Sauvie Island Wildlife Area is located downstream of the Site between the Multnomah Channel and Columbia River and lacks a significant physical connection to the Willamette River. The Smith and Bybee Wetlands Natural Area is located downstream of the Site and may have a potential connection to the Willamette through the Columbia Slough at very high water flows. Turbidity and water quality impacts arising from project activities, as discussed in Section 3.1.2 and Section 3.1.3, are expected to dissipate quickly and be mostly confined to within 100 meters downstream from the source, and because they occur during the summer months, are expected to be under low-water flow conditions. Therefore, no direct impacts are anticipated resulting from turbidity or water quality impacts on the Sauvie Island Area, and negligible impacts are expected for the Smith and Bybee Wetland Area. Removal of contaminants from within the Site may have a secondary beneficial impact on these areas.

Remedial activities, including dredging, capping, in-Situ treatment, EMNR, and removal and installation of piles and structures, are not anticipated to occur within any of the areas

identified as Special Habitat Sites by the City of Portland. However, remedial activities may occur adjacent to these areas, as shown on Figure 3-4. As described in Section 5.4, measures would be implemented following remedial activities to restore substrate, slope, and natural cover to the extent possible to maintain habitat and function that would be altered during implementation of the proposed action, and compensatory mitigation would be required to address remaining impacts. Therefore, adverse impacts on Special Habitat Sites are not anticipated.

#### **3.3.1.4 CDF**

Construction of a CDF at Terminal 4 would not result in impacts on sanctuaries or refuges.

### **3.3.2 Wetlands**

Section 404 of the CWA regulates the discharge of fill into waters, including wetlands, of the United States. The Willamette River is a navigable stream and therefore a “water of the United States.” In addition to being a navigable river of the United States, the Willamette River can also be characterized as a wetland under the Cowardin et al. (1979) system, a scientific rather than regulatory classification system. In contrast to the broader Cowardin scientific definition of wetlands, the CWA Section 404 guidance is slightly more narrowly focused on more “typical” types of wetlands and states:

"The term wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." 40 CFR § 230.3(t).

The State of Oregon statutes at 196.800(16) and Oregon Administrative Rules at 141-085-0010 rely upon the CWA Section 404 definition to define jurisdictional wetlands. For the purposes of this evaluation, the Willamette River itself is not considered to be a wetland under the CWA definition but rather a water of the United States due to its navigability. However, there are specific locations within the Site that meet the CWA definition of wetlands, as described below.

#### **3.3.2.1 Existing Conditions**

Anchor QEA mapped wetlands in the Study Area using existing information (National Wetlands Inventory and the State of Oregon wetlands information) and looking at hydric soils and vegetative cover to identify potential wetland areas (**Figure 3-5a-d**). The identified wetlands are based upon the Oregon wetland dataset and map the area from ordinary high water (OHW) to ordinary low water (Oregon Natural Heritage Information Center 2009).

According to the maps produced from the Oregon wetland data, aside from riverine wetlands, there are only two locations in the Lower Willamette River below the OHW where other types of wetlands (in this case, Palustrine) are present, as shown on **Figure 3-**

**5d.** One of these two areas is classified as palustrine scrub shrub wetland at RM 3, near the confluence of Multnomah Channel. There would be no remedial activities in this area; therefore, this wetland area will not be impacted. The other wetland area identified is a palustrine emergent seasonal at the head of Slip 1 at the Port of Portland's Terminal 4. This wetland area would be impacted by the construction of the proposed CDF. Existing conditions for this wetland are described below.

The wetland area at Terminal 4 is described as a vegetated area in the shallow waters at the head of Slip 1 (BBL 2005). This area supports shrubs and medium sized trees adjacent to the water and is occasionally submerged. It is surrounded by impervious surfaces in the upland and dock structures in the water. The slopes in the shoreline of this area are steep, and significant amounts of riprap are present (BBL 2005). Although ecological conditions in the slip may meet the definition of a wetland, the quality and function of this area as habitat is most likely constrained and impaired by industrial activity and surrounding upland development.

### **3.3.2.2 No Action**

The No Action alternative would not result in impacts on wetlands.

### **3.3.2.3 Remedial Activities including Dredging, Capping, In-Situ Treatment, ENR, and Removal and Installation of Piles and Structures**

Remedial activities, including dredging, capping, in-situ treatment, ENR, and removal and installation of piles and structures, are not anticipated to occur within wetland areas, with one exception as described in Section 3.3.2.4 below.

### **3.3.2.4 CDF**

Construction of a CDF at Terminal 4 would result in the permanent loss of wetland habitat in Slip 1. This would be a significant adverse impact on wetlands. Compensatory mitigation would be required to replace lost wetland habitat, as described in Section 6.

## **3.3.3 Mudflats**

Mudflats are defined in 40 CFR §230.42 as "broad flat areas along the sea coast and in coastal rivers to the head of tidal influence and in inland lakes, ponds, and riverine systems." Mudflats are generally composed of exposed mud and are established over time through sedimentation by rivers or tides. These habitat types support a variety of wildlife, particularly migratory birds. Due to extensive shoreline modifications, including riprap and seawalls, and historic maintenance dredging within the navigation channel, no mudflat areas are known to exist within the Site. Aerial imagery and documentation suggest that mudflats do not exist within the Site (U.S. Department of Agriculture [USDA] 2005, 2009). Review of the publicly available 2010 aerial imagery indicates that the mudflats have been altered or removed altogether, either as a result of shoreline development or dredging activities. The river plan for the north reach of the Lower Willamette River, Natural Resources Inventory: Riparian Corridors and Wildlife Habitat identifies no mudflats existing within any of the North Reach inventory sites located within or adjacent to the Site (City of Portland 2009).



Because no mudflats are documented to exist within the Site, no impacts on mudflats would occur. It is expected that SMA-specific habitat assessments would occur prior to implementation of the proposed action, and any mudflat areas identified at that time would be assessed for potential impacts and the need for compensatory mitigation.

### **3.3.4 Vegetated Shallows**

Vegetated shallows are defined in 40 CFR §230.43 as “permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation, such as turtle grass and eelgrass, in estuarine or marine systems as well as a number freshwater species in rivers and lakes.” Shallow water habitats are limited to the narrow strip between the shoreline and the navigation channel, which within the Site is vulnerable to disturbance and anthropogenic alteration due to its proximity to shoreline. Vegetated shallows may exist in some areas within the ACM and natural beach areas.

#### **3.3.4.1 Existing Conditions**

Based on available information, vegetated shallows have been identified at a single location in the Site, at the head of the Terminal 4 Slip 1 (BBL 2005). This area is located adjacent to/contiguous with the palustrine wetland area described above and shown in **Figure 3-5d**. The Port of Portland determined that the vegetated shallows at Slip 1 are not likely to be habitat for mammals, such as mink, because of its degraded nature and isolation from other habitats (BBL 2005). The identification of other vegetated shallows would require fieldwork within the Site; effective assessments cannot be feasibly conducted through the review of aerial imagery. It is possible that additional sites may be located during SMA-specific habitat assessments conducted at the time of remedial design.

#### **3.3.4.2 No Action**

The No Action alternative would not result in impacts on vegetated shallows.

#### **3.3.4.3 Remedial Activities including Dredging, Capping, In-Situ Treatment, ENR, and Removal and Installation of Piles and Structures**

Remedial activities, including dredging, capping, in-situ treatment, ENR, and removal and installation of piles and structures, are not anticipated to occur within vegetated shallows, with one exception as described in Section 3.3.4.4 below. It is expected that SMA-specific habitat assessments would occur prior to implementation of the proposed action, and any vegetated shallows areas identified at that time would be assessed for potential impacts. Measures described in Section 5.4 would be implemented following remedial activities to restore substrate, slope, and natural cover to the extent possible to maintain habitat and function that would be altered during implementation of the proposed action. Compensatory mitigation may be required to address remaining impacts to vegetated shallows.

#### **3.3.4.4 CDF**

Removal of the vegetated shallows as a result of the development of the proposed CDF at

Terminal 4 would result in a significant adverse impact. Compensatory mitigation would be required to address this impact, as described in Section 6.

### 3.3.5 Riffle and Pool Complexes

Riffle and pool complexes are defined in 40 CFR §230.45 as areas of steep gradient streams with “rapid movement of water over a coarse substrate in riffles [that] results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. Pools are characterized by a slower stream velocity, a streaming flow, a smooth surface, and a finer substrate.” Because the Willamette River within the Site does not have a steep gradient, and because it is channelized and the shoreline contains extensive modifications, including riprap and seawalls, it is highly unlikely that riffle and pool complexes exist within the Site; therefore, no impacts are anticipated. It is expected that SMA-specific habitat assessments would occur prior to implementation of the proposed action, and any riffle and pool complexes identified at that time would be assessed for potential impacts and the need for compensatory mitigation.

### 3.3.6 Shorelines and Riparian Habitats

#### 3.3.6.1 Existing Conditions

The existing conditions of shorelines are described in Section 3.1 and Section 3.1.1.1 and **Figure 3-3a-d** shows the shoreline condition within the Site. The existing conditions of riparian habitats are described in Section 3.2.1.1, and the presence of natural cover along the shoreline is shown in **Figure 3-6a-e**.

#### 3.3.6.2 No Action

The No Action alternative would not result in impacts to shorelines with natural cover or riparian habitats.

#### 3.3.6.3 Remedial Activities including Dredging, Capping, In-Situ Treatment, ENR, and Removal and Installation of Piles and Structures

Although this would be avoided to the extent possible, the placement of engineered caps with riprap armor in shallow water areas where there is currently no armoring would have an adverse impact on shorelines, as described in Section 3.1.1.4. Compensatory mitigation would be required to replace lost habitat and forage area, as described in Section 6.

Similarly, finished river bank slopes would be less than 5H:1V; however, current industrial and commercial operations may have structures that preclude obtaining this desired slope following remedial action. Additionally, many of the contaminated river banks extend into upland areas that preclude removal of the contamination. Consequently, caps likely will need to be placed on many of these banks. Armored caps are assumed to be placed on river banks where the slope exceeds 1.7H:1V and on river banks in the main channel that are prone to erosive forces. Vegetation is assumed to be used for river banks in off-channel areas that are not prone to erosion and with slopes less

than 1.7H:1V. However, it may not be possible to restore natural cover in all of the areas where it is disturbed. Compensatory mitigation would be required to address this impact.

#### **3.3.6.4 CDF**

Removal of the shoreline and riparian habitat as a result of the development of the proposed CDF at Terminal 4 would result in a significant adverse impact. Compensatory mitigation would be required to address this impact, as described in Section 6.

#### **3.3.7 Floodplains**

As described in Section 3.1.4.1, floodplain connectivity is highly degraded at the Site, and remedial activities would not alter these conditions. The potential for impacts on floodplain storage capacity is discussed in Section 3.1.4.5 related to impacts on normal water fluctuations. Based on HEC-2 modeling of the proposed CDF at Terminal 4, the rise in flood stage at and just upstream of Terminal 4 would be negligible and would meet federal and City of Portland criteria (BBL 2005).

### **3.4 POTENTIAL EFFECTS ON HUMAN USE CHARACTERISTICS**

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This section discusses the variety of human uses of the Site and potential impacts from remedial activities.

#### **3.4.1 Municipal and Private Water Supplies**

The Oregon State Water Resources Department Water Rights Information Query Database documents 10 Points of Diversion for water rights permits held by five owners allowing water to be withdrawn from the Willamette River within the Site (Oregon Water Resources Department 2011). All of the water intake sources currently existing within the Site are used to supply water for industrial and manufacturing uses, with only one point of diversion having irrigation as its designated use. No water is permitted to be withdrawn from the Site for human consumption (non-drinking water only), there are no current municipal or private plans to withdraw water from the Site for drinking water purposes, and it is unlikely that water from the Site would be used for drinking water purposes due to the significant alternative protected resources of the Bull Run Watershed (City of Portland 2008).

Existing permitted water rights are not expected to be influenced by the implementation of remedial activities. As indicated above, remedial activities are likely to have negligible impact on water flow or fluctuations. Short-term water quality may be impacted in the vicinity of these water intakes, but this would be a short-term impact, and it is not anticipated that short-term water quality changes (such as increased turbidity or contaminant concentrations) would impede use of the water for industrial and manufacturing purposes or municipal purposes such as fire protection. Intakes located upstream and downstream of the Site are anticipated to remain unaffected by implementation of remedial activities.

### **3.4.2 Recreational, Commercial, and Subsistence Fisheries**

This section describes the fisheries uses of the Site and potential impacts from the remedial actions.

#### **3.4.2.1 Existing Conditions**

Recreational fishing is popular in the Lower Willamette River, both by boat and from locations along the shoreline (EPA 2011). Target fish species include spring Chinook salmon, steelhead, coho salmon, shad, crappie, bass, and white sturgeon (DEQ 2000). Spring Chinook contribute to the sport and recreational fishery in the Lower Willamette River. The salmonid fishery is supplemented by hatchery fish, which are the fish primarily available for harvest (EPA 2000). The fishery for warm water species, such as carp, bass, and crappie, along with hatchery steelhead and Chinook salmon, is open the entire year, with catch limits that vary by species. There are several restrictions on recreational fisheries (ODFW 2016).

There are no reports of commercial fisheries for resident fish or anadromous salmonids currently operating on the Lower Willamette River. ODFW has records for crayfish collection in Multnomah County in 2015, but these records do not indicate whether the collection actually occurs within the Site (ODFW 2015). A ban on crayfish harvest was imposed by the OHA in 1991 for the McCormick and Baxter Superfund site, which is within the Site (OHA 2010). The McCormick and Baxter Superfund site contained contaminated sediment over approximately 20 acres, which was remediated and capped in 2005. The 1991 ban on crayfish collection was lifted in 2010 based on improved conditions after remediation (OHA 2010). Even if collection does occur within the Site, it is not indicated whether those crayfish are consumed by humans or used as bait (ODFW 2015).

In addition, some population groups use the Site for subsistence fishing. The most commonly consumed species in the area include carp, brown bullhead, crappie, and smallmouth bass. In addition, the Lower Willamette River provides a ceremonial and subsistence fishery for Native American tribes consisting primarily of Pacific lamprey and spring Chinook salmon, based on a fish consumption survey conducted on the reservations of the participating tribes and completed in 1994 by the Columbia River Inter-Tribal Fish Commission (CRITFC). Four Native American tribes (Yakama, Umatilla, Nez Perce, and Warm Springs) participated in the study (CRITFC 1994). Based on the CRITFC study, tribal exposure to contaminants in fish was evaluated in the human health risk assessment using a consumption rate of a mixed diet consisting of both resident and anadromous fish at a consumption rate of 175 grams per day (approximately twenty-three 8-oz meals per month). This rate is the 95<sup>th</sup> percentile of consumption rates for consumers and non-consumers in the CRITFC survey and is considered high compared to other population groups. Therefore, this is a conservative estimate of exposure to contaminants through fish consumption.

The risk assessment concluded that PCBs and dioxin/furans in fish tissue are the most significant contributor to potentially unacceptable risk in the Portland Harbor Site. PAH

impacts on benthic invertebrates are also significant but areas are localized. In addition, while PAHs bioaccumulate in shellfish in concentrations that pose a potentially unacceptable risk to people, PAHs are metabolized in fish, thus, reducing contaminant concentrations in fish tissue.

In June 2004, the State of Oregon issued a health advisory for Portland Harbor that limited the recommended consumption of resident fish (i.e., non-anadromous fish) in the vicinity of Portland Harbor due to concerns regarding levels of PCBs found in these fish. Although potentially unacceptable human health contaminant risks from human consumption of fish from the Site will not be eliminated through the remedial activities, the potentially unacceptable human health risks are expected to be reduced. One potential outcome would be the potential relaxation of fish advisories over time.

#### **3.4.2.2 No Action**

The No Action alternative would not result in additional impacts on fisheries. Contaminants would continue to pose unacceptable risk to benthic invertebrates and fish, and the unacceptable human health risks from consumption would continue.

#### **3.4.2.3 Remedial Activities**

Remedial activities, including dredging, capping, in-situ treatment, ENR, removal and installation of piles and structures, and construction of a CDF, potentially would have some temporary short-term effects on fish and fishing success and angling opportunities in the Site. Fishing activities likely would be displaced from the Site in the vicinity of the construction activities during the in-water work window between July 1 and October 31. Although salmon and steelhead fishing for hatchery fish occurs year-round in the Lower Willamette River, construction would take place during the recommended in-water work window when the fewest number of salmon species are expected to be in the Lower Willamette River, therefore, minimizing any impact on this recreational fishery. Terminal 4 is a slip area owned by Port of Portland and already posted with restrictions on the upland and in-water sides. Therefore, construction of a CDF at Terminal 4 would not result in impacts to current fishing access, though it would preclude any future fishing opportunities .

Impacts to habitat function resulting from conversion from shallow water habitat to deep water habitat as a result of remedial activities are anticipated to be addressed through compensatory mitigation as described in Section 6. As a result of placement of engineered caps, restrictions on navigation may result in decreased access to certain areas of the shoreline for purposes of recreational fishing. The potential impacts on fish species and habitat resulting from habitat conversion due to unsuitable cap substrate surfaces (such as large rock) are anticipated to be addressed through compensatory mitigation.

The reduced potential risks over the long-term may result in a reduction or relaxation of existing fishing bans and advisories for resident fish and, thus, provide more recreational fishing opportunities. Fishing for anadromous fish is not currently impacted because the advisories do not apply to anadromous fish.

### 3.4.3 Water-Related Recreation

This section describes water-related recreational use of the Site and potential impacts from remedial activities.

#### 3.4.3.1 Existing Conditions

Water-related recreation that is common throughout the Site includes recreational boating, personal motorized recreational watercraft use (e.g., jet skis), and wakeboarding, primarily during the summer months. Due to the extensive commercial and industrial use of the Lower Willamette River, recreational in-water activities, such as swimming, SCUBA diving, and windsurfing, are not as common as in upstream reaches of the river. Diving activity appears to be minimal throughout the Site and is generally limited to commercial diving. The Portland Triathlon (with swimming, running, and biking components) started in 2007, and the swimming event takes place within the Site, beginning at Cathedral Park (Portlandtri.com 2016). Additionally, recreational fishing is conducted throughout the Willamette River basin, including the Site, both by boaters and from locations along the shoreline.

There are some natural areas and water-related recreational opportunities both within the Lower Willamette River and along the shoreline. The most prominent location within the Study Area is Cathedral Park, located under the St. Johns Bridge at approximately RM 6.0 on the east side of the Lower Willamette River (see **Figure 3-4**). Cathedral Park was dedicated as a park in 1980, and its amenities include a sandy beach area and a public boat ramp, along with several acres of open green space. It is primarily used for boat launching, some waterfront recreation, and some swimming that may occasionally occur in the shallow water area.

Some recreational or transient beach use may occur at the Linnton beach area on the west side of the river at RM 5.0, although it is not designated for recreational use (Kennedy/Jenks 2011). Beach use also may occur within Willamette Cove (see **Figure 3-4**), but this area was designated a public health hazard by Oregon Department of Health and Human Services (2003). The City of Portland has indicated it would like to have this area become an urban natural area with passive recreation opportunities in the future (City of Portland 2009). There are several public beaches on Sauvie Island, but these are generally along the Multnomah Channel or Columbia River, which are not within the Site. Swan Island Lagoon includes a public boat ramp, but there is limited beach habitat available here, and the surrounding industrial environment limits the type of recreational activity that may occur here for safety reasons. The Willamette River Recreation Guide, published by the Oregon State Marine Board (OSMB) and Oregon State Parks (OSP), warns recreational boaters to beware of large commercial vessels navigating about Portland Harbor (OSP and OSMB 1998).

In 2010, OHA issued a public health assessment for recreational use of Portland Harbor, which concluded that:

- People who regularly recreate (i.e., boat, swim, beach comb, and other activities)

at the former Gasco site beach over several years may be exposed to PAHs at levels that may increase their risk of developing cancer at some time in their lives. However, it is unlikely that this beach is presently being used recreationally on a regular basis.

- Swallowing or touching chemical contaminants in water, beach sediment, and bottom sediment at other beaches is not expected to harm the health of people who recreate (i.e., boat, swim, beach comb, and other activities) or work within the Portland Harbor Superfund Site.
- Although not site-related, water contact of any kind near combined sewer overflow areas during the rainy season could cause bacteria-related illness.

The OHA reviewed the data from hundreds of environmental samples collected from water, fish, soil, and river bottom sediment in the Site. These data were used to assess the health risk for people who use the harbor area recreationally.

#### **3.4.3.2 No Action**

The No Action alternative would not result in impacts on water-related recreation, and any potential health risks would remain unchanged.

#### **3.4.3.3 Remedial Activities**

As a result of the implementation of the remedy, some areas may become restricted to navigation or otherwise have restricted access in order to ensure the long-term stability and viability of the remedy. For example, engineered capping areas along the shoreline may be posted with No Trespassing or Restricted Navigation Area signage. Additional low or no wake zones may be established within portions of the Site. Temporary water quality impacts are expected to be localized to the construction area where recreational activities generally would be excluded during construction. Terminal 4 is a slip area owned by Port of Portland and already posted with restrictions on the upland and in-water sides. Therefore, construction of a CDF at Terminal 4 would not result in impacts on current water-related recreation, though it would preclude those activities in the future.

#### **3.4.4 Houseboats and Marinas**

There are no houseboats or marinas within the Site. Houseboats and marinas are located upstream of the Site within the Willamette River and downstream of the Site within the Columbia River. The nearest houseboat community and marina to the Site are located in Multnomah Channel between the entrance to Multnomah Channel and the Sauvie Island Bridge. Due to the proximity of this marina and houseboat community to the Site, there is a potential for remedial activities to impact this area if contaminants released during implementation are transported into Multnomah Channel. However, implementation of the BMPs described in Section 5 would avoid or minimize the release of contaminants during remedial activities. Therefore, impacts on houseboats and marinas are not anticipated.

### **3.4.5 Aesthetics**

This section describes aesthetics of the Site and potential impacts from remedial activities.

#### **3.4.5.1 Existing Conditions**

The Site is located within the Portland metropolitan area. Adjacent properties within the Site are primarily zoned as heavy industrial and river industrial and are located within the River Industrial Greenway Overlay Zone (City of Portland 2011). According to Portland City Code 33.440.030(A)(4), the River Industrial Greenway Overlay Zone “encourages and promotes the development of river-dependent and river-related industries which strengthen the economic viability of Portland as a marine shipping and industrial harbor, while preserving and enhancing the riparian habitat and providing public access where practical.” The aesthetic nature of the Site is characterized by its urban setting and includes a variety of recreational, commercial, and industrial uses.

The Site is located within a heavily industrialized reach of the Lower Willamette River, with numerous manufacturing, shipbuilding, petroleum storage and distribution, metals salvaging, and electrical power generation activities. As noted in other sections, the Site has been extensively modified by wetland draining, channelization, and dredging for creation and maintenance of the navigation channel and ship berthing areas. Large barges, tugs, and ocean-going cargo vessels are frequently seen in Portland Harbor along with trucks and other large pieces of machinery.

There are no National Wild and Scenic Rivers (Rivers.gov 2016) or National Scenic Byways within the Site (ODOT 2016). The City of Portland Municipal Code §33.480.040 contains development standards that protect specific views of Mt. Hood and the Lower Willamette River per the City of Portland Scenic Resources Protection Plan (City of Portland 1991a).

The Scenic Resources Protection Plan contains provisions that establish height restrictions for buildings within the view corridor of Mount Hood in downtown Portland (City of Portland 1991a). The protected Lower Willamette River view corridors occur along the west bank in three specific locations, including Salmon Springs, the south end of River Place, and between Marquam and Ross Island Bridges; the Springwater Line (Belrose Line) is additionally considered as a scenic corridor (City of Portland 1991b).

The Willamette River is also protected within the “Greenway” area, which is intended to “protect and preserve the natural and economic qualities of lands along the Willamette River through implementation of the City’s Willamette River Greenway Plan” (Oregon State 2010). The proposed action is intended to improve public safety by removing contaminants from the sediment in the Willamette River, thereby adhering to the Greenway Plan’s goal of providing “for the maintenance of public safety” (Oregon State 2010).

#### **3.4.5.2 No Action**



The No Action alternative would not result in impacts on aesthetics.

#### **3.4.5.3 Remedial Activities**

Potential impacts on aesthetics from the implementation of the remedial activities would result from additional vessels, including tug boats, barges, cranes and backhoes, and dredges on the river during the in-water work window. However, construction equipment involved in the removal or in-place treatment is substantially similar to the equipment that is typically found in a working harbor area. There would be also be aesthetic impacts due to lighting during nighttime work, particularly for residences with view sheds of the Lower Willamette River, which include the homes between RM 2 and 3, University of Portland campus dormitories at RM 8, and the homes at RM 11.

The conversion of aquatic area to upland as a result of the proposed CDF at Terminal 4 would create a minor change to the immediate area but would not alter the overall character of the Site due to the changing nature of the commercial and industrial setting that surrounds the area.

#### **3.4.6 Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves**

This section describes existing conditions with respect to parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves, and potential impacts from remedial activities.

##### **3.4.6.1 Existing Conditions**

Parks within the vicinity of the Site include Forest Park, Linnton Park, and Cathedral Park (see **Figure 3-4**). Forest Park is an approximately 5,000-acre park that stretches along the west side of Northwest St. Helens Road from approximately RM 3 to RM 10, a significant distance upland outside of the Site. Forest Park contains Linnton Park, an approximately 300-acre park, both of which do not contain waterfront access (PP&R 2011). Cathedral Park is an approximately 23-acre park located at the east terminus of St. Johns Bridge. Recreational amenities at Cathedral Park include a boat dock, boat ramp, and pedestrian paths.

The Eastbank Esplanade (officially Vera Katz Eastbank Esplanade) is a pedestrian and bicycle path along the east shore of the Willamette River, just upstream of the Site. The Eastbank Esplanade also includes docks that are used for recreational activities, including swimming and kayaking. Tom McCall Waterfront Park is located on the west side of the Willamette River, with pedestrian and biking trails that extend to the north just upstream of the Site.

The St. Johns Bridge is an approximately 1,200-foot suspension bridge that was completed in 1931 and underwent extensive renovation in 2003 to 2005. The bridge is currently designated as an official historic landmark (PP&R 2011).

There are no natural or historic monuments, national seashores, wilderness areas,

research sites, or other similar preserves within the Site or its vicinity aside from those areas described in Sections 3.2.1.1 and Section 3.4.3.1 (Archaeological Investigations Northwest, Inc. [AINW] 2005; National Park Service 2016).

#### **3.4.6.2 No Action**

The No Action alternative would not result in impacts on parks, national and historic monuments, national seashores, wilderness areas, research sites, or similar preserves.

#### **3.4.6.3 Remedial Activities**

Water-related recreation would be temporarily impeded by remedial activities due to noise and construction activity. This is expected to be a short-term and localized impact, effective only while the in-water work is being conducted. Potential water quality impacts are unlikely to present additional impacts to recreational users at park areas because the recreational use would likely be excluded from construction areas, and water quality exceedances are expected to be localized to the construction area. No impacts to Forest Park or Linnton Park are anticipated from implementation of remedial activities because these parks are in upland areas outside of the Site boundaries. Impacts on the Eastbank Esplanade and Waterfront Park are not anticipated, as these parks are upstream of the Site boundaries.

Cathedral Park is the only park that is adjacent to the Site. Impacts on this park may result from construction noise and access restrictions to the water during construction. In the long term, this park may be beneficially impacted in terms of public use and access once the sediments in the Lower Willamette River have been cleaned up and public perception of water-based recreation opportunities improves.

### **3.4.7 Other Factors in the Public Interest**

This section presents a discussion of other factors in the public interest, including economics, cultural resources and historical properties, navigation, and greenhouse gas emissions and green remediation measures. This section also describes potential impacts on these factors from remedial activities.

#### **3.4.7.1 Economics**

##### **3.4.7.1.1 Existing Conditions**

The lower Willamette River and its adjacent upland areas have been used for industrial, commercial, and shipping operations for over a century. Commercial and industrial development in Portland Harbor accelerated in the 1920s and again during and after World War II, which reinvigorated industry following the Great Depression. Before World War II, industrial development primarily included sawmills, manufactured gas production, bulk fuel terminals, and smaller industrial facilities. During World War II, a considerable number of ships were built at military shipyards located in Portland Harbor. Additional industrial operations located along the river in the post-World War II years included wood-treatment, agricultural chemical production, battery processing, ship loading and unloading, ship maintenance, repair and dismantling, chemical

manufacturing and distribution, metal recycling, steel mills, smelters, foundries, electrical production, marine shipping and associated operations, rail yards, and rail car manufacturing. Many of these operations continue today, and Portland Harbor plays a key economic role for the region, as evidenced by the following:

- One out of every 7.4 jobs in the City of Portland is located in or supported by the work done in the Portland Harbor Industrial District.
- Portland Harbor has a historic average annual growth rate of 3 percent and a forecasted growth rate of 3 percent.
- Industrial marine businesses with direct access to the harbor support approximately 52,784 direct, induced, and indirect local family-wage jobs (24,000 direct jobs), bringing almost \$3.5 billion in personal income and \$7.6 billion in business revenue to the region's economy annually.
- The income wage range for harbor jobs is \$65,000 to \$80,000 – higher than Portland's average household income of \$48,700.
- These jobs produce an annual tax benefit of \$351 million.
- The diversity of jobs allows for various levels of skills and/or education levels, providing job opportunities for many people (Martin Associates 2012; ECONorthwest 2013, as cited in WorkingWaterfrontPortland.org 2016).

#### **3.4.7.1.2 No Action**

The No Action alternative would not result in impacts on economics. The existing degraded condition of the Site would continue to impede recreational values, public use and access, and other factors related to economics.

#### **3.4.7.1.3 Remedial Activities**

As described in Section 8.8, the proposed action would have an overall positive impact on local economics although there would be short-term impacts on navigation, as described in Section 3.4.7.3.3, and water-related recreation. In addition, as described in Section 3.4.2.1, some minority populations and Native American tribes that rely on fishing would be impacted by consumption of impacted fish and aquatic resources to a higher degree than non-minority populations, and therefore, they would benefit from the proposed action.

#### **3.4.7.2 Cultural Resources and Historical Properties**

The Site is located within the Willamette Basin, a source of natural resources and transportation to the region for both current and prehistoric populations. A cultural resources investigation was completed in 2005 (AINW 2005). The investigation included a comprehensive review of both published and unpublished documents and other materials on the geology, past and present environmental settings, archaeology,

prehistory, Native peoples, and Euroamerican history of the Lower Willamette River region. Sources of information used in the report included the Oregon State Historic Preservation Office (SHPO), the Oregon Historical Society, the Multnomah County Library, the Portland State University library, the Oregon State Office of the U.S. Department of Interior -Bureau of Land Management, and USACE. Research was also conducted at the Emory Strong Research Library at the Columbia Gorge Interpretive Center Museum.

#### **3.4.7.2.1 Existing Conditions**

According to the AINW report, human use and occupation along the Lower Willamette River likely extends back in time 10,000 to 12,000 years (AINW 2005). This timeline covers the late Pleistocene and post-Pleistocene environments as well as what is known about the history of human settlement in the region. The end of the Pleistocene was approximately 12,000 years ago and coincides with the retreat of the last continental glacier (AINW 2005).

There have been few archaeological resources recorded in the Lower Willamette River research area to date. The report concluded that limited data likely result from the fast pace and geographical extent of development in this area over the past 150 years (which has destroyed or buried archaeological deposits) and the limited amount of archaeological fieldwork or research conducted in this area prior to the mid- to late 1970s (AINW 2005).

AINW reviewed SHPO records and other documents and indicated that 20 archaeological sites have been recorded or reported within the research area (AINW 2005). Twelve of these sites have been formally recorded with the SHPO; the remaining eight are sites reported by artifact collectors or by local residents. Possible archaeological sites are those sites that may contain historic-period archaeological deposits but for which there has been no archaeological investigation. There are 100 possible archaeological site locations within the research area.

Review of above-ground resources indicates that 27 previously recorded historic structures and 51 unrecorded historic structures are located within the research area, for a total of 78 above-ground resources. Of these resources that have been recorded:

- Nine are currently listed in the National Register of Historic Places (NRHP).
- Six are considered eligible for listing in the NRHP by Oregon SHPO but have not been submitted for listing.
- Two have been accorded local landmark status (listed as significant at the local level) by the City of West Linn.
- Eight were recorded as either Rank II or Rank III resources in the 1984 Portland Historic Resource Inventory Survey.
- Two have been recorded during cultural resources management projects but have

not been listed at the federal, state, or local level and have not had a determination of eligibility made by SHPO.

As mentioned previously, the St. Johns Bridge is currently designated as an official historic landmark (PP&R 2011).

#### **3.4.7.2.2 No Action**

The No Action alternative would not result in impacts on cultural or historical resources.

#### **3.4.7.2.3 Remedial Activities**

Much of the planned work for all alternatives is in the main channel of the Lower Willamette River. The active channel has little to no potential for cultural resources. Remedial activities such as dredging in shallow water or excavation of native soils beneath fill on river banks may have the potential to result in impacts on cultural resources, based on the cultural resources survey (AINW 2005). During remedial design, additional evaluation would be conducted to assure impacts on cultural resources are avoided. A cultural resources expert may be required to oversee remedial activities in areas where there is potential for artifacts or other cultural resources to be encountered.

#### **3.4.7.3 Navigation**

##### **3.4.7.3.1 Existing Conditions**

Portland Harbor has been extensively modified from its natural condition for the purposes of enhancing navigation and other water-dependent industrial activities. The Lower Willamette River federal navigation channel was initiated in the late 1890s following construction of the north and south jetties at the mouth of the Columbia River (USACE 2009). Following construction of the jetties, USACE initiated deepening of the Columbia River ship channel to 25 feet from the mouth of the Columbia River to Portland. Ship channel depths have increased over time in response to the size of vessels entering the Columbia River. The width of the Willamette River navigation channel varies between 600 and 1,900 feet, and the authorized depth is -40 feet Columbia River Datum (CRD). The current depth and length of the Lower Willamette River federal navigation channel was authorized by the 1962 Omnibus Bill for Rivers and Harbors, Public Law 87-874, October 23, 1962, which also authorized turning basins (USACE 2009).

Maintenance dredging of the Lower Willamette River federal navigation channel is necessary due to natural sedimentation processes. In 1997, due to the discovery of high levels of contaminants in the river sediment, USACE suspended maintenance dredging of the Lower Willamette River federal navigation channel (USACE 2008). Although certain slips and approach ways have been dredged in the years since the Site was listed, the Lower Willamette River federal navigation channel has not been maintained since 1997. A maintenance dredge action was proposed by USACE at the Post Office Bar location at RM 2.0 to 3.0 due to accumulation of material at a shoaling area, leading to unsafe navigation conditions (USACE 2009). The maintenance dredging was approved by NMFS via a Biological Opinion in 2010, and a Finding of No Significant Impact was re-

issued by USACE in 2011 (NMFS 2010; USACE 2011). Dredging was completed in October 2011.

#### **3.4.7.3.2 No Action**

The No Action alternative would not result in impacts on navigation.

#### **3.4.7.3.3 Remedial Activities**

Generally, construction activity may disrupt recreational and commercial navigation during in-water work periods. In addition, there are some navigable areas within the Site where capping may occur. Navigation of larger vessels in capping areas likely would be restricted; however, this would have a negligible impact on commerce because large vessels generally do not utilize these areas. There may also be some restrictions to smaller vessels in these areas such as no anchoring signs.

As discussed in the FS, any in-place treatment would be located in areas with the least impact to navigability and would therefore have negligible long-term impacts on navigation or navigability in the Site. The development of a CDF would result in the permanent displacement of berthing space for aquatic vessels in Slip 1 at Terminal 4. Mitigation to offset this impact to navigation may be developed during remedial design.

Long-term benefits to navigation will result from removing contaminated sediments from the Site and allowing maintenance dredging to occur in the federal navigation channel.

#### **3.4.7.4 Greenhouse Gas Emissions and Green Remediation**

Greenhouse gas emissions were considered in the FS as an additional measure of potential short-term impacts for each alternative. Generally, the mass of carbon dioxide equivalents emitted would increase with the quantities of removed sediments, volume of sediments disposed of off-Site, and the quantities of capping and CDF cover or berm materials placed due to the associated increase in energy requirements. However, the use of a CDF would reduce greenhouse gas emissions compared to trucking, barging or transporting contaminated sediments by rail to a landfill upstream on the Columbia River.

Applicable sustainability measures requested to assess “green remediation” measures are provided in the FS **Appendix N**.

### **3.5 TRANSPORT OF CONTAMINATED SEDIMENTS TO TRANSLOADING FACILITY ON THE COLUMBIA RIVER**

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Transportation of dredged material to upland disposal areas is not anticipated to impact water quality or aquatic or terrestrial wildlife.

Potential release of contaminated sediments during transport on barges and transloading of barges to rail or truck would be minimized according to BMPs and avoidance and minimization measures outlined in Section 5. Barges would be sealed to contain sediments and water, and spill-control equipment would be kept on hand to respond to releases. Secondary containment would be incorporated into the design of transload

facilities to capture contaminated materials that may escape from buckets while offloading barges or loading rail cars and trucks. If material is stockpiled at transload facilities, stockpiles will have curbing and sumps to facilitate the collection of runoff.

The specific location(s) of transloading facility along the Lower Columbia River would be identified during remedial design. While not anticipated due to the industrial nature of potential transloading facility locations, potential impacts on aesthetics, noise, and other factors in the public interest would be evaluated during remedial design.

## 4.0 EVALUATION AND TESTING OF DISCHARGE MATERIAL

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For the purposes of the remedial alternatives, it is assumed that all in-place remediation materials discharged as fill, including the residuals cover layer, will be obtained from a source that meets the standards for suitability of fill material according to specifications established at the time of the remedial design. This will generally mean that any materials imported to the Site will have low or non-detectable levels of contaminants that are not expected to have significant adverse impacts on water quality or biota in the short or long term.

Potential impacts on aquatic life from the use of activated carbon for in-situ treatment in some areas are discussed in Section 3.2.2.4.

Based on the extensive sampling of Site sediments documented in the RI report (LWG, as modified by EPA 2016), for proposed placement in the CDF, it is concluded that no additional testing of the existing sediments will be required to characterize the dredged or fill material, outside of SMA-specific testing during remedial design. SMA-specific testing for water column effects, effects on benthos, biological community structure, and other physical tests and evaluations may be warranted at the design level to address particular contaminant concerns or other SMA-specific issues. Additional site-specific documentation of this testing may be required to demonstrate substantive compliance with 40 CFR 230.61 of the CWA 404(b)(1) guidelines.

In addition, this finding is supported by guidance at 40 CFR 230.60(c) that states:

“Where the discharge site is adjacent to the extraction site and subject to the same sources of contaminants, and materials at the two sites are substantially similar, the fact that the material to be discharged may be a carrier of contaminants is not likely to result in degradation of the disposal site. In such circumstances, when dissolved material and suspended particulates can be controlled to prevent carrying pollutants to less contaminated areas, testing will not be required.”

After the berm is built, the CDF area would be enclosed from the river such that the placement of material in the CDF would not involve in-water work and there would be no potential for discharges of contaminated sediment from the CDF. Water discharged from the CDF during filling would be required to meet water quality standards. Additional discussion of the CDF alternative is provided in Section 3.1.3.5.



## IMPACT AVOIDANCE AND MINIMIZATION MEASURES

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Impact avoidance and minimization measures for the proposed action would apply to remedial technologies, including dredging, capping, piling and structure removal and installation implemented as part of the proposed action, and construction of compensatory mitigation projects. Section 3 of this 404(b)(1) analysis presents an evaluation of the potential impacts from the proposed action. The avoidance and minimization measures described in this section are measures taken to first avoid those impacts on the aquatic environment. Where impacts may be unavoidable, measures to minimize the impacts will be taken. The avoidance and minimization measures described in this section were developed as part of the FS and informed by previous BA analyses and associated BOs for removal actions that have taken place in the lower Willamette River, including Arkema, Gasco, and Terminal 4 Early Action sites.

Some of the minimization measures described in this section were developed to serve as “on-site mitigation” to be integrated into the remediation plan to maintain habitat and function that would be altered during implementation of the proposed action. As described in Section 5.4, these integrated minimization measures include the use of sand or beach mix as a final substrate layer following dredging and capping and the restoration of water depth, slope, riparian vegetation where possible, and river bank slope modification where applicable. These measures would be employed to avoid the need for compensatory mitigation (and are required to be considered prior to use of compensatory mitigation).

Given the general level of design in an FS, the degree of integrated minimization measures that will take place during implementation of the proposed action cannot be prescribed at this stage and will be determined during remedial design. It is anticipated that compensatory mitigation pursuant to CWA Section 404 will be required as part of the proposed action to offset impacts that cannot be avoided or minimized through the use of onsite measures described in this section. In lieu of SMA-specific information to be obtained during remedial design, a programmatic approach was used to estimate compensatory mitigation requirements for the FS. This is a useful and straightforward approach for the purposes of the FS, which is not expected to greatly impact the selection of the preferred alternative by EPA.

### 4.1 IN-WATER WORK

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The following impact avoidance and minimization measures will apply to all construction activities:

- The potential for adverse effects to ESA-listed species should be minimized to the degree possible by conducting all in-water work within an approved in-water work window when salmonids are expected to be either not present or present only in low numbers. The work window requirement is expected to apply to activities occurring in the water that have the potential to impact listed species. In-water work will be conducted between July 1 and October 31.

- Potential activities that would be conducted within an approved in-water work window include the following:
  - MNR monitoring – collection of biota for tissue sampling activities only
  - In-place technologies
  - Dredging and associated residual cover layer placement
  - Construction of the CDF berm
  - Removal and installation of pilings
  - Construction of in-water portions of compensatory mitigation projects
- Potential activities that can occur throughout the year outside of an in-water work window include but may not be limited to:
  - Filling of the CDF once the berm is complete
  - Surface sediment and surface water collection activities – this and other types of sampling and monitoring are expected to occur throughout the year due to the limited impact to aquatic species or habitat expected to result from these collection activities
  - Transport and offloading of sediment for upland placement – disposal of dredged material at a landfill is expected to occur throughout the year due to the limited impact expected to result from these activities
  - Removal and replacement of light structures such as floating docks (without pile driving) is expected to occur during any time period throughout the year due to the limited impact expected to result from this activity
  - Activities occurring in the dry or over the water are expected to occur outside of the work window with proper measures in place to prevent construction materials from dropping into the water
  - Activities occurring inside sheet pile wall containment that isolates the activity from the surrounding water column
- Water quality monitoring: Remedial actions will comply with detailed water quality monitoring and control requirements set forth in a WQMCCP water quality memo/plan. For dredging, it is assumed those requirements will include, at a minimum, turbidity, DO, and initial chemical constituent monitoring; sediment and contaminant dispersion control measures such as silt curtains, sheet pile

walls, and closed or environmental dredge buckets; and BMPs. In addition, an appropriate escalation of conditions could include work slowing/stoppage and/or additional monitoring if exceedances are detected or if injured or dead ESA-listed species or non ESA-listed species are observed in the project area, and if it is determined that the injuries are related to construction operations. NMFS law enforcement personnel should be notified, and fish should be handled with care to ensure effective treatment or analysis of cause of death or injury.

**Chemical parameter monitoring:** The requirements of chemical parameter monitoring, including compliance points and concentrations, would be established in a WQMCCP prior to SMA-specific project implementation.

**Turbidity monitoring:** In accordance with NMFS (2013), the following turbidity monitoring steps will be followed during remedial activities that have the potential to disturb sediments:

- Monitor turbidity using an appropriately and regularly calibrated turbidimeter, or a visual turbidity observation, every 4 hours when work is being completed or more often as necessary to ensure that the in-water work area is not contributing visible sediment to water. Samples should be collected upstream and downstream of the project area. If more turbidity or pollutants are visible downstream than upstream, the activity must be modified to reduce pollution. Continue to monitor every 4 hours or more often as necessary. If the exceedance continues after the second monitoring interval, the activity must stop until the pollutant level returns to background. If monitoring or inspections show that the pollution controls are ineffective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary.
- The compliance point for turbidity is 100 meters downstream of the expected location of the center of the in-water work activity. At the point of compliance, turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU. At no time should turbidity exceed 50 NTU over background. Should this occur, all in-water activities shall cease immediately, and EPA shall be notified. Work shall not resume until turbidity levels have returned to compliant levels and approval has been given by EPA.
- All monitoring station locations will be determined using a laser range finder, which is accurate to within  $\pm 1$  meter. Sampling depths for turbidity will be located at the approximate top, middle, and bottom of the water column if the water depth permits collecting samples from three intervals separated by at least 5 feet from each other. Top and bottom samples will

be taken 1 foot below the surface of the water and above the mud line, respectively. Thus, for water depths less than 7 feet, two samples will be collected, and for water depths less than 2 feet, one sample will be collected.

- Background turbidity will be established prior to the start of any active in-water work. A minimum of seven independent measurements at all applicable water depths will be made at least 100 meters upstream of the expected location of the center of the in-water work activity just prior to construction initiation. The upstream distance for monitoring background conditions should target a relatively undisturbed and unimpacted area upcurrent from the work area, considering tidal influence. For NTU measurements, the 90th percentile upper confidence limit on the mean will be used to represent initial background conditions.
- As the Lower Willamette River is tidally influenced, if flow reversal is observed to occur during monitoring, the sampling stations will be reversed to continue the down-current and up-current (for background conditions) pattern as appropriate. Measurements of current velocities and/or turbidity plumes will be required to confirm field observations and decisions on monitoring locations relative to tidal influence.

Monitoring frequency:

- Turbidity will be measured at the start of each operation at least once every hour during active in-water work. Background turbidity will be measured at the approximate top, middle, and bottom of the water column at a frequency to be determined based on site-specific conditions. On any day active in-water work occurs, the first compliance sample will be taken a minimum of 1 hour after the initiation of the activity and once at each 1-hour interval thereafter. This frequency of monitoring for turbidity will continue until four consecutive hourly events indicate no exceedance of any trigger levels. If no exceedance is identified following four consecutive hourly events, the sampling frequency will be reduced to every 4 hours. Hourly frequency will resume if a turbidity exceedance has been confirmed and corrected.

Reporting:

- Turbidity exceedances will be reported as soon as possible on the day of measurement verbally or by email to EPA so that response decisions can be coordinated. As noted above, all in-water activities shall cease immediately if there is a turbidity exceedance. Work shall not resume until turbidity levels have returned to compliant levels and approval has been given by EPA.

Contingency measures:

- In addition to turbidity monitoring, the cause of any observed silt plume generated by construction activities will be assessed, and appropriate measures (e.g., change production rates, modify work schedule, perform work on a slower flow) will be taken in consultation with EPA to correct an identified problem if project operations are determined to be the source.
- During construction activities that have the potential to produce sheens, surface booms, oil-absorbent pads, and/or similar materials should be on site and available for use.
- Prior to entering the water, all equipment should be checked for leaks and completely cleaned of any external petroleum products, hydraulic fluid, coolants, and other deleterious materials.
- Work barges should not ground out on the river bottom.
- Waste materials should be disposed of in an appropriate location according to the properties of the waste.
- Demolition and construction materials should generally not be stored in areas where materials could easily enter surface waters.
- A Spill Prevention Containment and Countermeasure (SPCC) Plan should be developed for activities that have the potential to spill petroleum products and for general construction-related impacts to minimize potential adverse effects as follows:
  - The SPCC Plan should discuss construction planning elements and recognize potential spill sources at the Site. The SPCC Plan should discuss potential responsive actions in the event of a spill or release and provide notification and reporting procedures. The SPCC Plan should contain contractor management elements such as personnel responsibilities, project site security, site inspections, and training.
  - The SPCC Plan should describe measures that could be taken by the contractor to prevent the release or spread of hazardous materials, either found on site and encountered during construction but not identified in contract documents or any hazardous materials that the contractor stores, uses, or generates on the construction site during construction activities.
  - The contractor should maintain at the job site the applicable equipment and material designated in the SPCC Plan.
- Fish capture and removal: Whenever work isolation is required and aquatic

species, including ESA-listed fish, are likely to be present, the applicant must attempt to capture and remove the fish as follows (NMFS 2013):

- If practicable, allow aquatic species to migrate out of the work area or remove fish before dewatering; otherwise, remove fish from an exclusion area as it is slowly dewatered with methods such as hand or dip-nets, seining, and trapping with minnow traps (or gee-minnow traps).
- Fish capture must be supervised by a qualified fisheries biologist with experience in work area isolation and competent to ensure the safe handling of all fish.
- Conduct fish capture activities during periods of the day with the coolest air and water temperatures possible, normally early in the morning to minimize stress and injury of species present.
- Monitor the nets frequently enough to ensure they stay secured to the banks and free of organic accumulation.
- Electrofishing may be used only after other means of fish capture are determined to be not feasible or ineffective during the coolest time of day.
  - Do not electrofish when the water appears turbid (e.g., when objects are not visible at a depth of 12 inches).
  - Do not intentionally contact fish with the anode.
  - Follow NMFS (2000) electrofishing guidelines, including use of only direct current (DC) or pulsed direct current within the following ranges:
    - If conductivity is less than 100 microsiemens ( $\mu$ S), use 900 to 1,100 volts.
    - If conductivity is between 100 and 300  $\mu$ S, use 500 to 800 volts.
    - If conductivity is greater than 300  $\mu$ S, use less than 400 volts.
  - Begin electrofishing with a minimum pulse width and recommended voltage, then gradually increase to the point where fish are immobilized.
  - Immediately discontinue electrofishing if fish are killed or injured (i.e., dark bands visible on the body, spinal deformations,

significant descaling, torpid, or inability to maintain upright attitude after sufficient recovery time). Recheck machine settings, water temperature, and conductivity and adjust or postpone procedures as necessary to reduce injuries.

- If buckets are used to transport fish:
  - Minimize the time fish are in a transport bucket.
  - Keep buckets in shaded areas or, if no shade is available, covered by a canopy.
  - Limit the number of fish within a bucket; fish will be of relatively comparable size to minimize predation.
  - Use aerators or replace the water in the buckets at least every 15 minutes with cold clear water.
  - Release fish in an area upstream with adequate cover and flow refuge; downstream is acceptable, provided the release site is below the influence of construction.
  - Be careful to avoid mortality counting errors.
- Monitor and record fish presence, handling, and injury during all phases of fish capture and submit a fish salvage report to NMFS within 10 days.
- Contaminant monitoring: Monitoring for one or more key COCs will be conducted for dredging and for certain capping projects to ensure BMPs are effective at reducing not only turbidity from the work, but also off-site migration of dissolved and particulate COCs. This monitoring may include measures like surface, mid water column, and near bottom water samples and other measures such as sediment traps. Site-specific plans will outline what COCs will be monitored and whether acute or chronic criteria will be applied and where. Plans will also make clear how tiered monitoring of turbidity and chemistry will work. Chemistry monitoring can be reduced or discontinued for longer term projects where elevated levels are not detected from in-water work.
- Piling removal – general BMPs: Use the following steps to minimize creosote release, sediment disturbance, and sediment resuspension:
  1. Prior to commencement of the work, the project engineer or contractor should assess the condition of the piling and identify whether piling will be removed using a barge or upland equipment. The contractor's work plan must include procedures for extracting and handling piling that break off during removal. In general, complete extraction of piling

is always preferable to partial removal.

2. When possible, removal of treated wood piling should occur in dry or during low water conditions. Doing so increases the chances that the piling will not be broken (greater visibility by the operator) and increases the chances of retrieval in the event that piling are broken.
  3. The crane operator shall remove piling slowly. This will minimize turbidity in the water column as well as sediment disturbance.
  4. The operator shall minimize overall damage to treated wood piling during removal. In particular, treated wood piling must not be broken off intentionally by twisting, bending, or other deformation. This will help reduce the release of wood-treating compounds (e.g., creosote) and wood debris to the water column and sediments.
  5. Upon removal from the substrate and water column, the piling shall be moved expeditiously into the containment area for processing and disposal at an approved offsite, upland facility (see #24 and #25 below).
  6. The piling shall not be shaken, hosed-off, stripped or scraped off, left hanging to drip, or any other action intended to clean or remove adhering material from the piling. Any sediment associated with removed piling must not be returned to the waterway. Adhered sediments associated with treated piling are likely contaminated and may, along with piling, require special handling and disposal.
  7. The operator shall make multiple attempts to remove a pile before resorting to cutting.
- Piling removal – vibratory extraction-specific BMPs:
- Vibratory extraction is the preferred method of piling removal because it causes the least disturbance to the seabed, river, or lake bed, and it typically results in the complete removal of the piling from the aquatic environment.
8. The operator should "wake up" piling by vibrating to break the skin friction bond between piling and sediment. This bond breaking avoids pulling out a large block of sediment and possibly breaking off the piling in the process.
- Piling removal – direct pull extraction-specific BMPs:

Direct pull extraction refers to the removal of piling by grabbing or wrapping the piling and then directly pulling the piling from the sediment, using a crane or



other large machinery. For example, piling are wrapped with a choker cable or chain and removed by crane with a direct upward pull. Another method could involve an excavator with a pincer attachment that can grasp a pile and remove it with a direct upward pull. The use of direct pull can be combined with initial vibratory extraction.

9. Excavation of sediment from around the base of a pile may be required to gain access to portions of the pile that are sound and to allow for extraction using direct pull methods. Excavation may be performed in the dry at low tide or in the water using divers. Hydraulic jetting devices should not be used to move sediment away from piling in order to minimize turbidity and releases to the water column and surrounding sediments.

- Piling removal – clamshell bucket extraction-specific BMPs:

Clamshell removal of piling uses a barge-based or upland excavator-mounted clamshell bucket. The clamshell is lowered from a crane and the jaws grasp the piling stub as the crane pulls up. Clamshell bucket extraction has the potential to disturb sediments if deployed close to the sediment surface and increases the likelihood of damaging piling which can result in incomplete removal of a pile. However, a clamshell bucket may be needed when broken or damaged piling cannot be removed using vibratory or direct pull extraction methods. Extraction with a clamshell might be the best way to remove piling that were cut at or below the mudline previously and have little or no stub accessible above the mudline.

10. To the extent possible, clamshell extraction should be performed in the dry during low tide, low river flows, or reservoir draw-down. Under these conditions, the operator can see the removal site and piling, improving the chance for full removal of piling.
11. Since sediment management is potentially a larger concern when using a bucket, every effort should be made to properly size the bucket to the job and operate it in ways that minimize sediment disturbance.
12. Excavation of sediment from around the base of a pile may be needed to gain access to portions of the pile that are sound and to allow for extraction using a clam shell. Excavation may be performed in the dry at low tide or in the water using divers. Hydraulic jetting devices should not be used to move sediment away from piling in order to minimize turbidity and releases to the water column and surrounding sediments.
13. Because clamshell extraction has a higher potential to generate debris, it is particularly important that an offshore boom be in place with this

removal technique. If treated wood piling are being removed, extracted piles shall be transferred to the containment basin without leaving the boomed area to prevent loss of treated wood chemicals (e.g., creosote) and debris to the water column and sediments.

14. The operator must minimize pinching of treated wood and overall damage to treated wood piling during removal. This will help reduce the potential for releasing treated wood chemicals (e.g., creosote) and debris to the water column and sediments.
  15. No grubbing for broken piling is allowed.
- Additional pile removal BMPs for locations with contaminated sediments:
    - During project planning, consider that the best tidal condition for piling removal will be dictated by the specifics of the removal. For example, in some circumstances water access for removal equipment at high tide may be less disturbing to the sediment than access in the dry at low tide. In others, removal in the dry is the best option.
    - During project planning, consider the pros/cons of each method and its potential to disturb contaminated sediments. For example, while a clamshell bucket may be more feasible for removal of buried or broken piling, it is also more likely to disturb sediments. It may be preferable to manually excavate and remove by direct pull.
    - Based on EPA's experience at numerous Superfund cleanup sites (e.g., Pacific Sound Resources, Olympic View, Ketchikan Pulp Mill, and Lockheed), extraction of piling is not expected to result in exposure to subsurface contaminated sediments via an exposed "hole." Therefore EPA does not require placement of sand prior to or after pile pulling unless it is part of an overall project design such as a cap. Undocumented placement of clean sand may complicate future characterization efforts at cleanup sites.
    - If piling removal results in exceedance of turbidity or other water quality standards at the compliance boundary, reconsider the timing of removal to a more restricted time frame, for example, the lowest practical tide condition or around slack water.
  - Piling removal – pile cutting-specific BMPs:

Pile cutting shall be considered a last resort following multiple attempts to fully extract piling using vibratory, direct pull, and/or clamshell bucket extraction. On a project-specific basis, pile cutting may be appropriate to maintain slope stability or if a pile is broken and cannot be removed by other methods. A pneumatic

underwater chainsaw, shearing equipment, or other equipment should be used to cut a pile.

16. Piling shall be cut below the mudline, with consideration given to the mudline elevation, slope, and stability of the site.
  17. In intertidal and shallow subtidal areas (shallower than -10 feet mean lower low water [MLLW]) seasonal accretion and erosion of the nearshore and/or beach can expose cutoff piling. In these locations, piling should be cut off at least 2 feet below the mudline. In deeper subtidal areas (deeper than -10 feet MLLW), piling should be cut off at least 1 foot below the mudline.
  18. Hand excavation of sediment (with divers in subtidal areas) is needed to gain access for cutting equipment. To minimize turbidity and releases to the water column and surrounding sediments, hydraulic jetting devices shall not be used to move sediment away from piling.
  19. As a condition of their permit, the permittee will be required to provide a post-construction drawing/map to USACE for the Administrative Record, which shows the location and number of piling left in place (above and below mudline) with the global positioning system (GPS) location(s) in North American Datum of 1983. The permittee will also be required to provide this information to the property owner(s).
- Additional pile cutting BMPs for locations with contaminated sediments:
    - Complete removal of piling from the environment is preferred. When necessary, project-specific requirements (including equipment selection) for cutting shall be set by the project engineer and coordinated with EPA and any other appropriate resource agencies, considering the mudline elevation, slope and stability of the site, and the condition of the piling.
    - If cutting is required, the appropriate depth below mudline for cutting should be made on a project-specific basis, with the goal of minimizing both the resuspension of contaminated sediments and release of wood treatment chemicals.
    - For projects with derelict treated pile stubs that cannot be removed, consideration should be given to either leaving these in place or, if possible, cutting them below the mudline. Cutting the pile at the mudline may release PAHs into the water column. If a sand cover is placed over the cut pile, this may help contain the PAHs; however, the new sediment may move over time, and the pile may be exposed again.
    - The decision to leave piling in place that were originally slated for

removal must be coordinated with EPA and any other appropriate resource agencies. For example, if the work is being performed as part of a state or federal cleanup, the decision to leave piling in place, as well as documentation, must be coordinated with the agency with cleanup oversight.

- Piling removal – debris control BMPs:

The following BMPs apply to all piling removal activities regardless of the extraction/cutting technique:

20. All work should be confined to within a floating containment boom. The need for, type, and size of the boom should be determined on a project-specific basis, considering project size, habitat, water flow conditions, sediment quality, etc. A description of boom placement and management must be included in the permit application. A small boat should be available at all times during active construction to manage the boom and captured debris. If used, anchors must be removed once the project is complete.
21. For projects removing treated wood piling or a pier with wood components (like decking), a floating boom with absorbent pads must be installed to capture floating surface debris and any creosote sheen.
  - The boom shall be located at a sufficient distance from all sides of the structure or piling that are being removed to ensure contaminated materials are captured.
  - Extracted piles shall be transferred to the containment basin without leaving the boomed area to prevent loss of treated wood chemicals (e.g., creosote) and debris to the water column and sediments.
  - The boom shall stay in its original location until any sheen present from removed piling has been absorbed by the boom or removed utilizing absorbent material.
22. Any shavings, sawdust, woody debris (splintered wood, fragments, loose piling) on the water or sediment surface must be retrieved and placed in the containment area. Likewise any pile-associated sediment and adhered organisms must be collected daily, contained on site, and ultimately disposed at an approved upland disposal site along with the extracted piling and decking.
23. When asphalt or other decking is removed, the contractor shall prevent

asphalt grit or other debris on the pier from entering the water. Prior to demolition, the contractor shall remove as much of the surface asphalt grit and debris as possible. Floating platforms, suspended tarps, or other means should be deployed under and around the structure to capture grit and debris.

- Piling removal – piling storage, handling and disposal BMPs:

The following BMPs apply to all piling and associated piling-derived debris:

24. Upon removal from the substrate, the piling and associated sediments shall be moved expeditiously from the water into a containment area on the barge deck, adjacent pier, or upland area.
  25. The containment area shall be constructed in such a fashion as to restrict any release of contaminants or debris to the aquatic environment. Containment areas on barges, piers and upland areas shall have continuous sidewalls and controls as necessary (e.g., straw bales, oil absorbent boom, ecology blocks, durable plastic sheeting or lining, covers, etc.) to contain all sediment, wood-treating compounds, organisms and debris and to prevent re-entry of these materials into the aquatic environment.
  26. Any floating debris, splintered wood, or sediment removed during pile pulling must be placed in a containment area.
  27. Any sediments, construction debris/residue, and plastic sheeting from the containment basin shall be removed and disposed in accordance with applicable federal and state regulations. For disposal, this will require shipment to an approved Subtitle D Landfill.
- Additional pile storage, handling and disposal BMPs for locations with contaminated sediments:
    - Pre-project planning shall include measures to minimize water contact with piling and associated contaminated sediments. For example, the containment area can be designed to be covered during precipitation and when not in use, and/or piling and associated sediment can be quickly moved to a final disposal location and not retained at the project site.
    - Water collected in a containment area may require special management or treatment, depending on project specifics. In some cases, water may be stored in Baker tanks and treated off site. In others, a treatment system may be constructed on site. Discharge water must meet the requirements of the Clean Water Act, including the requirements of an NPDES permit (or substantive requirements) in order to discharge to surface water.

- Piling placement – piling material BMPs:
  28. Piling may be made of steel, concrete, plastic, or untreated wood. For large structural replacements, EPA encourages installation of piling made of concrete, steel, or plastic.
  
- Piling placement – general BMPs:
  29. Wood, concrete, steel, or plastic piling may be installed using vibratory methods and/or an impact hammer. Vibratory methods are typically preferred as they reduce impacts to fish listed under the ESA though this method may be combined with impact hammer for proofing. At the design phase, it is recommended that the applicant contact the USFWS and NMFS to request technical assistance on conservation measures that could be incorporated into the project to minimize impacts to listed species.
  30. Hydraulic jetting devices shall not be used to place piling.
  31. When a pile is being repaired using splicing or other methods, the permittee shall prevent the introduction of construction-related materials into the aquatic environment. For example, wet concrete must be prevented from entering waters of the state, and forms/sleeves made of impervious materials must remain in place until concrete is cured. Additionally, when a maintenance or repair method requires cleaning of piling (e.g. removal of encrusting organisms), any removed material must be captured and disposed upland.
  32. When steel or plastic piling are reused in the aquatic environment, any sediment adhered to piling or remaining inside of hollow piling must first be removed and disposed of upland at an appropriate location. Creosote-treated piling may not be reused.
  33. When proposing to reuse piling, the applicant must evaluate whether there is the potential to transport invasive species from the source area and ensure their complete removal such that there is no opportunity for transport/transfer of invasive species. For more information on areas of concern for the spread of invasive species and procedures for minimizing the spread of invasive species through de-contamination, see <http://www.ecy.wa.gov/programs/eap/InvasiveSpecies/AIS-PublicVersion.html>.

- Pile driving with an impact hammer: When using an impact hammer to drive or proof steel piles, one of the following sound attenuation methods must be used:
  - Completely isolate the pile from flowing water by dewatering the area around the pile.
  - If water velocity is 1.6 feet per second or less, surround the piling being driven by a confined or unconfined bubble curtain (Wursig et al. 2000; Longmuir and Lively 2001) that will distribute small air bubbles around 100 percent of the piling perimeter for the full depth of the water column.
  - If water velocity is greater than 1.6 feet per second, surround the piling being driven by a confined bubble curtain (e.g., a bubble ring surrounded by a fabric or non-metallic sleeve) that will distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column.
- Recommended measures for protection of Pacific lamprey ammocoetes in Sediment (USFWS 2010):
  - Survey using electrofishing methods outlined in USFWS 2010 to determine whether ammocoetes occupy the area, preferably at the project planning stage and when the project is implemented.
  - Identify areas adjacent to ammocoete habitat outside of the disturbance area but within the channel and dig holes (e.g., few scoops with a backhoe) where ammocoetes may take refuge as dewatering occurs. Cover these 'refuge' holes to protect them from predators.
  - Dewater slowly over several days or at a minimum overnight. Ramping flows, particularly during hours of darkness, can be effective in encouraging ammocoetes to move out of areas of impact.
  - Try an experimental technique; there is some evidence to suggest that if straw bales are placed in habitats where ammocoetes are present, they will move into the straw as dewatering occurs and can be removed safely the next day. If successful, document and provide this information to USFWS.

## **4.2 DREDGING**

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### **4.2.1 Sediment Dispersion Control Methods and Equipment**

All dredges cause some re-suspension of sediment. The amount is generally less than 1 percent of the mass of sediment removed, and re-suspension can be controlled (Palermo 2005). Water-borne transport of re-suspended contaminated sediment released during dredging often can be reduced by using physical barriers around the dredging operation

area, mechanical control techniques on the dredge equipment, and implementation of BMPs.

### **Physical Barriers**

Two of the more common approaches of physical barriers include silt curtains and sheet pile walls although several other designs are available that have been proven effective. Silt curtains are floating barriers designed to control the dispersion of sediment in a body of water. They are made of impervious flexible materials such as polyester-reinforced thermoplastic (vinyl) and coated nylon. The effectiveness of silt curtains is primarily determined by the hydrodynamic conditions in a specific location. Under ideal conditions, turbidity levels in the water column outside the curtain can be as much as 80 to 90 percent lower than the levels inside or upstream of the curtain (Francingues and Palermo 2005). Conditions that may reduce the effectiveness of these and other types of barriers include significant currents, high winds, changing water levels and current direction (i.e., tidal fluctuation), excessive wave height, and drifting ice and debris (EPA 2005). Silt curtains are generally more effective in relatively shallow (<10 feet), quiescent water. As water depth and turbulence due to currents and waves increase, it becomes more difficult to effectively isolate the dredging operation from the ambient water.

The use of silt curtains is not expected to be effective in the main channel of the Study Area during dredging operations due to the presence of significant currents, tidal fluctuations, and large debris. Consideration has been given to the use of silt curtains at off-channel areas (coves, embayments, slips, and lagoons) where the water velocities are much lower. In areas with working ship traffic, this approach would require developing a method for quickly removing and reinstalling the silt curtain during barge unloading operations. Silt curtains are retained for further consideration during remedial design.

Sheet piling consists of a series of panels and piling with interlocking connections driven into the subsurface with impact or vibratory hammers to form an impermeable barrier. While the sheets can be made from a variety of materials, such as steel, vinyl, plastic, wood, recast concrete, and fiberglass, lightweight materials (plastic, fiberglass, vinyl) are typically surface mounted to the piling.

Sheet pile containment structures are more likely to provide reliable containment of re-suspended sediment than silt curtains, although at significantly higher cost and with different technological limitations. Sheet piling must be imbedded sufficiently deep into the subsurface to ensure that the sheet pile structure will withstand hydraulic forces (such as waves and currents) and the weight of material (if any) piled behind the sheeting. Sheet pile containment may increase the potential for scour around the outside of the containment area and sediment re-suspension may occur during placement and removal of the structures. The use of sheet piling may significantly change the carrying capacity of a stream or river and make it temporarily more susceptible to flooding (EPA 2005). Sheet piling may be used in localized areas to prevent migration of highly contaminated sediment during dredging or during disposal operations. Sheet piling is retained for further consideration during remedial design.



### **Mechanical Control Techniques**

Mechanical control techniques are available for mechanical and hydraulic dredges, as well as backhoes. Because conditions vary greatly throughout the study area, these equipment modifications are not considered standard practice and will be used where environmental conditions in the study area indicate they will perform well and where there is the need for them.

Conventional mechanical dredging equipment, such as dredges that use a clamshell bucket, bucket ladder, or dipper and dragline, are inappropriate for environmental dredging (Interstate Technology & Regulatory Council [ITRC] 2014). The closed or environmental bucket is a specially designed dredging bucket that can reduce or eliminate increased turbidity during dredging. Clamshell dredge buckets can also be fitted with baffles, seals and lids (“top hats”) to slow the loss or movement of contaminated water and sediment. USACE used this type of seal, which is similar to a rubber gasket, at the Fox River and Green Bay sites to minimize leakage of PCB-contaminated water and sediment from the bucket.

Additional modifications to conventional mechanical dredging equipment based on site-specific conditions include (ITRC 2014):

- Fitting the crane with longer boom (arm) for additional reach during dredging
- Fitting an excavator with a longer arm for better access
- Using a fixed arm bucket instead of a cable suspended bucket to increase the accuracy and precision of cuts and provide greater bucket penetration in stiffer materials
- Equipping the bucket with hydraulically operated closure arms to reduce bucket leakage
- Installing a sediment dewatering and water collection and treatment facility on the barge or at a temporary staging site
- Installing GPS or other bucket monitoring equipment to provide the equipment operator with precise coordinate control of the bucket during dredging operations

Recent developments in hydraulic dredging equipment typically have included project- or site-specific modifications in order to achieve the following objectives (ITRC 2014):

- Increase solids content in the dredged material and lower water content
- Prevent debris from entering the auger or pump intake
- Pump dredged material over greater heights or distances

- Improve on shore dewatering of dredged material
- Reduce potential for releasing dredged sediment into the water column

Backhoes can be modified or equipped with covers for the bucket to improve retention of the sediment and minimize re-suspension.

Other control technologies include:

- Pneuma pump. The Pneuma pump is used primarily for removal of fine-grained sediment and offers high solids concentration (up to 90 percent) in the dredge slurry, with minimal turbidity.
- Large capacity dredges. Larger than normal dredges designed to carry larger loads. This allows less traffic and fewer dumps, thereby providing less disturbance at a disposal site.
- Precision dredging. Dredging utilizing special tools and techniques to restrict the material dredged to that specifically identified. This may mean thin layers, either surficial or imbedded, or precise prism boundaries.

#### **4.2.2 Best Management Practices for Dredge Operations**

BMPs or operator-control techniques are important in preventing re-suspension of contaminated sediment. Different types of dredges require different operating practices to control sediment re-suspension. For any dredging operation, sediment re-suspension should be monitored and operations halted if needed to avoid excessive re-suspension of sediment. Examples of BMPs for different types of dredges include (ITRC 2014):

- Operators of bucket dredges can (1) slow the dredge cycle time, which reduces the velocity of the bucket hitting the river bottom; (2) eliminate multiple bites (the practice of “multiple bites” involves repetitive lowering, raising, and reopening the bucket to obtain a fuller sediment load); (3) avoid stockpiling of silty dredged material on the river bottom; (4) rinse the bucket at the barge to clean off excess sediment between loads; and (5) briefly stop the bucket at the waterline to allow excess water to drain before raising the bucket from the water.
- Operators of cutter head dredges can (1) reduce rotation speed of the cutter head; (2) reduce the cutter head swing speed so the dredge does not move through the cut faster than it can hydraulically pump the sediment; (3) increase pump rates to provide more suction; (4) operate just below the sediment surface to avoid exposed blades or too deep cutting; and (5) avoid bank undercutting by removing sediment in lifts that are less than or equal to 80 percent of cutter head diameter to reduce cave-ins and sloughing of sediment.
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As described in Fuglevand and Webb (2012), when dredging with an environmental mechanical dredge using an enclosed bucket, each bucket of material placed in the barge contains a portion of sediment and a portion of water because water is not allowed to drain from the bucket. Failure to manage the water in the barge during dredging can result in the release of turbid water back into the dredged area, with the potential for increased sediment re-suspension and release and additional generated residuals. The active removal (pumping) and collection of water from sediment barges during dredging prevents the release of turbid water and can lessen sediment re-suspension and contaminant releases. The approach eliminates overflow from the sediment barges and has been successfully incorporated as a BMP at large-scale removals in Puget Sound (AMEC Environment & Infrastructure, Inc. 2013). The purpose of the BMP is to limit release of sediment and associated contaminants back into the waterway from the sediment barge. The findings from a case study of mechanical dredging document that barge overflow can represent a significant contribution to the formation of a residual layer of sediment (Dalton Olmsted & Fuglevand Inc. 2006), directly impact water quality, and create a risk for off-site contamination.

Implementation of this BMP can include activities, such as pumping of the excess water from the sediment barges during dredging, thereby limiting the amount of ponded water within the barge and preventing direct overflow from the barge back to the waterway. Removed water is pumped to a water management system designed to remove excess sediment and chemicals of concern prior to discharge of the water back to the waterway as dredging return water. With proper capture and management, the turbid water placed in a barge by the enclosed dredging bucket can be processed to remove suspended sediment and chemicals of concern that would otherwise be released back into the waterway causing releases (Fuglevand and Webb 2012).

#### **4.2.2.1 General Dredge Operations for all Dredging Types**

- An appropriate dredge sequencing strategy would be developed to minimize sediment with higher contamination levels from dispersing into adjacent areas.
- Experienced dredge operators should generally be used for dredging activities.
- Contractor vessel draft and movement should be done carefully within dredge areas during construction to limit the potential for scour.
- The potential for scour during construction should be managed to the extent practicable through careful movement of contractor vessel draft, and movement should be performed carefully within dredge areas during construction to limit the potential for scour.
- Spuds or anchoring systems must be designed and operated carefully within contaminated dredge areas to limit the potential for resuspension of sediments.
- The location of material removal should be confirmed using a GPS or similar device.

- Any sediment dewater generated should be either released pursuant to applicable discharge requirements although SMA-specific cases may be identified where elutriate should not be released to surface waters.

#### **4.2.2.2 Mechanical Dredge Methods**

- Bottom or beach stockpiling should be avoided.
- Taking multiple bites with the clamshell bucket should be avoided under most situations.
- Overfilling of the bucket should be avoided.
- The details of water quality monitoring will vary with SMA-specific approved water quality monitoring plans. A typical approach is that if an exceedance of water quality criteria (as defined by the SMA-specific water quality monitoring plan) is detected during mechanical dredging, a sequence of responses will be initiated, including implementation of additional controls to be determined as needed. The details and sequence of the steps will be developed and presented during remedial design. Based on recent studies as discussed in the FS, operational controls (as opposed to a silt curtain or similar device) are considered the most effective measures for control of turbidity and contaminant dispersion during dredging. Examples of possible operational controls that could be implemented on specific mechanical dredging projects as determined in remedial design include the following:
  - Reduce the velocity of the ascending loaded bucket through the water column, which reduces the potential to wash sediment from the bucket and reduces the sediment loading into the water column over a set period of time.
  - Pause the bucket at the bottom before hoisting the bucket through the water column to allow any overage to settle near the bottom.
  - Decrease the velocity of the descending empty bucket through the water column, which reduces the potential to overfill a bucket in soft sediments, or resuspend sediment due to energy of the bucket contacting the bottom.
  - Close the bucket slowly on the bottom.
  - Reduce the amount of material in each bucket load.
  - Confirm that all the material has been placed into the barge from the bucket before returning the bucket to the water to take another bite of material.
  - Use closed or environmental bucket. This technology consists of specially

constructed dredging buckets designed to reduce or eliminate increased turbidity in the water column. Environmental buckets are not suitable in certain situations, including situations with sediments of medium or greater density or in areas with substantial debris, which can prevent the bucket from closing properly. If not properly used, environmental buckets can exacerbate sediment resuspension in some situations.

- Requiring a debris sweep prior to dredging in known debris areas (debris caught in dredging equipment can cause additional resuspension and release of contaminated sediments).
- Properly selecting the dredge bucket for site conditions (i.e., soft sediment versus debris and/or hard digging).
- Minimizing the potential for slope failures by maintaining stable side slopes during dredging (e.g., shallow top-to-bottom cuts).
- Limiting operations during relatively high water velocity conditions (turbulence in the vicinity of the dredge bucket during high-flow conditions can cause additional resuspension and release of contaminated sediments).
- Preventing “sweeping” or leveling by pushing bottom sediments around with dredge equipment to achieve required elevations.
- Preventing interim in-water stockpiling of dredged material.

#### **4.2.2.3 Hydraulic Dredge Methods**

- During hydraulic dredging, the cutterhead should in most instances be maintained in the substrate and not be raised more than 3 feet above the river bottom when the dredge pumps are running to minimize entrainment of fish.
- As mentioned above for mechanical dredging, the details of water quality monitoring will vary with approved SMA-specific water quality monitoring plans. A typical approach is that if an exceedance of water quality criteria is detected during hydraulic dredging, a sequence of responses should be initiated, including implementation of additional controls to be determined as needed. The details and sequence of the steps should be developed and presented during remedial design. As discussed in the FS, based on recent studies, operational controls (as opposed to a silt curtain or similar devices) are considered the most effective measure for control of turbidity and contaminant dispersion during dredging. Examples of possible operational responses that could be implemented if water quality criteria are exceeded on specific hydraulic dredging projects as determined in remedial design include the following:
  - Reduce cutterhead rotation speed. Reducing cutterhead rotation speed

reduces the potential for side casting the excavated sediment away from the suction entrance and resuspending sediment.

- Reduce swing speed. Reducing the swing speed ensures that the dredge head does not move through the cut faster than it can hydraulically pump the sediment. Reducing swing speed reduces the volume of resuspended sediment. The goal is to swing the dredge head at a speed that allows as much of the disturbed sediment as possible to be immediately removed with the hydraulic flow. Typical swing speeds are 5 to 30 feet/minute.
- Eliminate bank undercutting. Removing sediment in maximum lifts equal to 80 percent or less of the cutterhead diameter reduces potential for side sloughing.

#### **4.3 PLACEMENT OF MATERIALS FOR CAPPING, IN-SITU TREATMENT, AND ENR**

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##### **4.3.1 Residuals**

Residuals refer to contaminated sediments remaining in or adjacent to the footprint after dredging is completed (Palermo et al. 2008). Recent field analyses at other sites have shown that the mass of contaminants released during dredging is typically 1 percent of the total contaminant mass removed if a dredge residuals cover layer is placed soon after dredging, and if dredging BMPs are implemented (USACE 2013).

- Place dredge residuals cover layer soon after dredging to limit release of contaminants. This is best accomplished with a 12-inch layer of sand applied over the dredge area as soon as possible (i.e., promptly after the design dredge elevation has been met).
- Sediment cores are assumed to be taken through the post-dredge thin sand layer to confirm that the required layer of sand has been applied to manage residuals. These cores will be taken once the thin sand layers have been applied.
- A 12-inch sand layer is assumed for all dredge areas to control residuals and releases.
- In areas where PTW is present, 5 percent activated carbon is assumed to be mixed with the residual layer.
- Erosion control measures are assumed to either divert surface water flows/runoff around and away from excavations or limit off-site transport of eroded river bank materials.
  - Sheet piles can be used to isolate ongoing excavations from erosive hydrodynamic forces if river stage increases during excavation.

- Permeable berms (e.g., straw waddles) can be used if sheet piles are not feasible.

#### 4.3.2 Resuspension

Current velocities greater than 2.5 feet per second may limit implementation and effectiveness of silt curtain controls, thereby increasing contaminant release rates/mass being transported away from the in-water work area during dredging activities (Palermo et al. 2008). However, dredging is assumed to occur during the approved in-water work window when river currents are low.

- Silt curtains are assumed to be feasible in current velocities less than 2.5 feet per second. Silt curtains are assumed in water depths less than 50 feet and in areas where NAPL is not present.
- A combination of silt and bubble curtains were unable to prevent multiple water quality criteria exceedances downstream of the 2005 Gasco removal action involving NAPL (Parametrix 2006). It is likely that the presence of NAPL contributed to the observed water quality exceedances.
- Engineered rigid control measures (such as sheet piles) may minimize NAPL and sediment releases outside of the sheet pile enclosed work area. These measures will be incorporated into any remediation alternative involving the presence of NAPL.
- As evidenced by recent environmental dredging projects in the Pacific Northwest, dredging BMPs can greatly lessen contaminated sediment releases, residuals, and resuspension. The following BMPs have been effectively used at the Boeing Plant 2 portion of the Lower Duwamish Waterway Superfund Site (adapted from AMEC 2012) and are assumed to be implemented at the Portland Harbor Site:
  - Develop an accurate digital terrain model of sediment contamination depth.
  - Develop a dredging plan, including over-dredge allowance, which will remove the targeted material in a single dredging event.
  - Dredge each SMA to the required depth, verify with bathymetric surveys, and cover with a thin sand residuals layer.
  - Ensure accurate bucket placement by using global positioning systems with sub-foot accuracy.
  - Use stair-step dredge cuts to reduce sediment sloughing along steeper slopes.

#### **4.3.3 In-place Avoidance and Minimization Measures**

- The placement of material should generally occur starting at lower elevations and working to higher elevations.
- Set volume, tonnage, lead line measurements, and bathymetry information or similar should be used to confirm adequate coverage during and following material placement.
- Imported materials should consist of clean, granular material free of roots, organic material, contaminants, and all other deleterious material.
- If an exceedance of water quality criteria is detected during any type of in-place technology construction activity, a sequence of responses should be initiated according to an approved SMA-specific water quality monitoring plan, including implementation of additional controls to be determined as needed. The details and sequence of the steps should be developed and presented during remedial design. As with dredging, operational controls (as opposed to a silt curtain or similar device) are considered the most effective measure for control of turbidity during placement of material. Examples of possible operational controls that could be implemented during placement of material, as determined during remedial design, are provided below:
  - Placement activities should be progressively slowed until turbidity exceedances are no longer detected outside of the compliance boundary to minimize sediment suspension. This is similar to the measure of decreasing dredging cycle times to decrease turbidity plumes until the suspended sediment settles.
  - Following slowing of capping activities, monitoring should continue, and operations should be modified in this manner as indicated in the terms of the approved SMA-specific water quality monitoring plan.

#### **4.4 ON-SITE MITIGATION MEASURES FOLLOWING DREDGING AND CAPPING**

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- Following dredging in shallow water areas (0 to 20 feet from ordinary low water), backfill would be used to restore the existing (pre-dredging) elevation to avoid loss of shallow water habitat.
- To offset permanent and/or temporal loss of habitat functions from dredging and capping in shallow water areas and as on-site mitigation, following dredging and capping in shallow water areas, slope would be laid back to as close to a 5H:1V slope as practicable given site-specific conditions.
- To further offset permanent and/or temporal loss of habitat functions from



dredging and capping on river banks and as on-site mitigation, after soil removal on river banks, river bank slopes would be laid back to as close as a 5H:1V slope as practicable given site-specific conditions.

- Capping in shallow areas would require dredging of an equivalent cap thickness (maximum of 3 feet) prior to placement to allow for a net zero bathymetry change and avoid loss of shallow water habitat.
- Engineered beach mix layer consisting of rounded gravel typically 2.5 inches or less would be applied to the uppermost layer of all caps and dredge leave surfaces in nearshore areas. This layer would provide appropriate substrate habitat for colonization by benthic organisms. Beach mix would not be applied to leave surfaces consisting of sand unless required due to changes in hydrodynamic conditions following remedial activities. In addition, if beach mix is placed over riprap armoring, monitoring would be required to determine whether the site-specific conditions are conducive to maintaining the beach mix habitat layer over the riprap. If monitoring or site-specific modeling demonstrate that a sand/gravel surface can be maintained long term, this may be considered by EPA when determining if the compensatory mitigation proposed during remedial design is adequate.
- Vegetation would be incorporated into caps placed on river banks where possible such as in off-channel areas that are not prone to erosion and with slopes less than 1.7H:1V.

#### **4.5 TRANSPORT AND OFFLOADING OF CONTAMINATED SEDIMENTS FROM BARGE TO TRUCK**

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- Standard barge loading controls should be observed to allow for safe movement of the barge and its material on its planned route.
- Where appropriate, a bin-barge or flat-deck barge with watertight sideboards and cover, or other similar measures, should be used to enclose dredged material, including dredged sediment and water, to prevent material from leaking from the bins or overtopping the walls of the barge.
- There will be no dewatering from the barge to the river at the transloading site.
- Improvements at the transload facility will include paving and sealing existing joints and transitions in the roadway. Wharf decking and all surfaces that can come in contact with dredged sediment and associated water must be made of solid (no slats) impermeable materials. Extruded asphalt curbing will be installed to corral precipitation and add a redundant mechanism to isolate potential spillage in the transloading process. If rainwater accumulates, it will be pumped from the wharf area.

- Sheeting or some type of impermeable lining must be placed under the travel area of the bucket to capture any spills. Spills outside of the area covered by the sheet will be cleaned up immediately. Dockside sediment control (e.g., sweeper truck, shoveling, sweeping, wash down) shall occur as often as necessary to avoid the tracking of sediment by vehicles and personnel and to maintain a clean site and shall include the dock, transload area, and the haul routes. A spotter will be present at all times to check that there is no leakage from the bucket before transferring material from the barge.
- Ecology blocks will be used to develop the drying agent containment area within reach of the load-out excavator..
- A custom fully-welded, watertight steel fabricated box will facilitate a large target for the equipment used to transfer the sediments to on-highway, 8-axle trucks and trailers. The walls of the box will be of sufficient height to eliminate the potential of splattering sediment outside of the containment as the clamshell opens. Transfer of dredged material should occur in a fashion that minimizes splash and splatter of the material.
- The transloading equipment must have a spill apron deployed between the barge and shore during off-loading operations to prevent the release of spilled material into the water.
  - The apron must be made of impermeable material and not have seams that would allow leakage into the water.
  - The apron will collect material dripped from rehandling equipment, including rainfall, and route it back into the barge or into a dock-side containment structure.
  - The spill apron must be wide enough that material will not fall off the sides and may include wing walls to increase the level of protection.
  - Material shall not be allowed to accumulate on the spill apron.
  - Containment measures (e.g., straw bales/wattles, filter fabric) should be used to capture water running down the apron.
  - The apron must be able to track up and down with the barge during tidal fluctuations in order to prevent separation of the apron from the barge.
- Before moving the crane/excavator, the spill apron and bucket must be decontaminated with a pressure washer and the water captured and contained. Wash water will not be left on the barge. Alternatively, the transloading set-up may include dedicated unloading equipment that would remain at the transloading dock.

- During set-up of the transloading facility, bed liners will be shipped and stored, the lining and truck bed covering stations will be constructed, and the truck haul routes (temporary pavement markers) will be established. Prior to load-out in the trucks, each bed will be fully lined with plastic before the sediments are loaded. Upon completion of loading the trucks, each truck bed will be covered prior to departure to the landfill. If sediment spillage occurs at the transfer point, the material will be immediately hand-shoveled, swept up, and incorporated into the load.
- Loading of the truck/railcars will take place within an exclusion zone, which will be established to contain any spilled material that may occur while loading. The exterior of the trucks and tires will be washed prior to leaving the loading area. All loads will be inspected to ensure no dredged materials are on the outside of the truck/rail car and the boxes are sealed and not leaking. Any spilled dredged material and water generated from cleaning the exterior of the trucks will be captured and either shipped off site with transloaded material or disposed of properly off site as described in the Stormwater Pollution Prevention Plan (SWPPP) (see below).
- Loading practices (e.g., partially loading to provide freeboard, loading near centerline of the car) will be employed to maximize liner effectiveness and prevent spillage.
- A wheel wash must be installed if sediment is getting on the deck (dock) where trucks or other vehicles are passing through.
- Wheel wash water cannot be allowed to enter surface waters or storm drains. Wheel wash wastewater must be collected and hauled off for proper disposal or routed to the sanitary sewer with proper local sewer district approval.
- "Trucks entering and leaving" signs will be installed on both sides of the road accessing the facility to establish notice to the public.
- Dust suppression will be handled with water misting of the sediment. A widespread water misting system will be strategically placed to moisten the exposed sediments and completely eliminate airborne particulates. In addition, dust will be fully suppressed at the surge/transload box by water misting. All water used for dust suppression will be contained within the barge.
- The truck loading procedure will be as follows:
  - Truck beds will be lined at the bed lining station.
  - Trucks will pull into the loading zone.
  - Sediments will be placed in the surge/transload box, if required due to

sediment characteristics.

- An excavator will supplement and mix the drying agent with the sediment as needed to absorb any moisture prior to loading in the truck.
  - Trucks will be loaded with special care to direct the material for transport to the landfill. On-board axle scales will facilitate loads to legal limits.
  - The loaded truck will be inspected for any latent spillage of sediment and immediately cleaned off.
  - The loaded truck will then move to the tarping station for load coverage prior to disembarking to the landfill.
  - Concurrently with the offload of sediment, submersible pumps will be available to pump off any free liquids generated in the process either in the transport barges or surge box. Water generated will be allowed to settle, and the water will be pumped off to a water hauler for disposal at an approved municipal treatment site or the landfill. Alternatively, water treatment may occur at the transloading facility under an approved water quality management plan. During pumping operations, all connections will be visually monitored for signs of leakage.
  - Housekeeping is imperative, and personnel will be dedicated to maintaining drip pans, haul routes, and truck decontamination through the entire cycle of operations.
- As a precaution, two Baker/Frak tanks will be permanently stationed at the facility to facilitate free liquids (if any) pumped off of the sediment transport barges. During pumping operations, all connections will be monitored visually for signs of leakage.
  - Stormwater management at the transload facility will include the following:
    - The facility will have an NPDES Industrial Stormwater General Permit, which will regulate all discharges to surface waters.
    - The facility will have an SWPPP that describes operational and structural source control BMPs related to barge material transloading. The SWPPP will be available for review by all involved or interested agencies.
    - The SWPPP will describe the routing and ultimate disposal of any water from the dredged material, all stormwater collected within the dredged material handling area, any water that is used for wash-down of trucks and equipment, and any water that may come in contact with the dredged material or dredged material handling equipment. No stormwater

associated with transloading will be discharged into the facility's stormwater treatment system or discharged back into the river unless it is covered under an NPDES permit and the SWPPP includes measures that ensure removal of the contaminants, which are sufficiently stringent to meet both acute and chronic Water Quality Criteria. If water is being treated at the facility for eventual discharge into the river, a water quality management plan must be submitted for approval prior to use of the facility and will include both physical (turbidity, pH, DO) and chemical (based on materials being handled at the facility) monitoring.

- The SWPPP will discuss the design storm criteria, including how big a storm event has been designed to be "zero discharge." The SWPPP will also discuss the contingency for overflows in excess of the design storm and controls to minimize stormwater adding to the water coming off the dredged sediments and the surrounding transload site.

#### **4.6 CONSTRUCTION OF A CDF**

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Avoidance and minimization measures and BMPs described above for dredging (Section 5.2) and placement of materials (Section 5.3) would be implemented during construction of the CDF berm to minimize the potential for increased suspended sediment and turbidity levels.

After the berm is built, the CDF area would be enclosed from the river such that there would be no in-water work and no potential for impacts related to turbidity. CDF fill rates will be controlled (and slowed as needed) to prevent berm overtopping. During filling, as water within the CDF begins to approach a level at which discharge would be necessary, filling would be slowed or stopped to prevent overflow. If discharge is necessary, water quality within the CDF would be sampled and characterized prior to discharge to confirm that water quality criteria will be achieved at the point of discharge from the CDF to be established through agency consultation on ESA and to comply with the substantive requirements of CWA Section 401. A detailed water quality monitoring plan similar to that being developed with the Port of Portland would be required.

#### **4.7 MONITORING**

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Monitoring is an integral component that will be conducted to evaluate short- and long-term effectiveness and whether the proposed action is meeting the remedial goals. The monitoring program will include sediment, surface water, pore water, and fish tissue samples collected at the following frequencies:

- Remedial baseline monitoring will be conducted prior to implementation of remedial activities to gage the performance of the remedy.
- Short-term remedial monitoring will be conducted every 2 years during implementation of remedial measures.

- Performance monitoring will commence the year following completion of remedy implementation and take place every 2 to 3 years for the first 10 years and once every 5 years thereafter.

#### **4.7.1 Release**

Release is the mechanism by which dredging or capping operations result in the transfer of contaminants from sediment pore water and sediment particles into the water column or air (USACE 2008). Monitoring of water quality parameters will be conducted throughout remedial activities in accordance with a WQMCCP that will outline actions to address water quality exceedances (such as increased dredge cycle times if water quality exceedances are resulting from dredging activities).

#### **4.7.2 Structures**

Pilings, docks, berthing or mooring dolphins, and other structures servicing active wharfs or shore-based facilities likely will remain intact during removal activities. To the extent practicable, a fixed arm environmental bucket dredge or excavator is assumed for removal of contaminated sediments and river bank materials located beneath and around these structures.

Other structures (such as dilapidated, obsolete, or temporary structures) will be removed prior to environmental dredging or excavation activities. All structures with foundations in contaminated sediments or river bank materials, and not servicing active wharfs or shore-based facilities, will be removed prior to dredging or excavation. Removal of these structures will incorporate water quality controls and monitoring to prevent the offsite transport of contaminated sediments, as described above.

#### **4.7.3 Enhanced Natural Recovery**

ENR is accomplished through the placement of a 12-inch layer of sand, which is sufficient to allow for mixing with the underlying sediment bed while also retaining clean sand above the mixed interval. In areas where PTW is present, 5 percent activated carbon is added to the sand layer.

Monitoring is an integral component of ENR and will be conducted to evaluate long term effectiveness. The monitoring program will include sediment, surface water, pore water, and fish tissue samples collected at the frequencies listed in Section 5.7 above.

#### **4.7.4 Monitored Natural Recovery Long-term Monitoring**

Monitoring of MNR areas may include biota tissue sampling and analysis (including resident fish species only), surface sediment sampling, and surface water sampling. Likely avoidance and minimization measures for long-term monitoring activities include the following:

- All biota collection activities should be conducted according to a field sampling plan and standard operating procedures (SOPs), or equivalent, similar to those

used to guide sample collection activities for the RI.

- Biota sampling will be scheduled to occur during fish windows to avoid impacts on ESA-listed species. However, it is still possible that listed species could be captured during biota sampling activities.
- Fish capture activities should be done carefully and in a way that targets the intended species, to the extent possible. If non-target species are captured, they should be returned to the river as quickly as possible.
- Boat and backpack electrofishing activities should be conducted by field staff appropriately trained for using electrofishing equipment.
- Surface sediment sample collection, processing, equipment decontamination, and disposal of waste activities should be conducted according to the field sampling plan and SOPs, or equivalent, similar to those used to guide sample collection activities for the RI.
- Surface sediment sample locations should be targeted and confirmed using a differential global positioning system with appropriate corrections and offsets for horizontal and vertical control.
- Surface water sample collection, processing, and equipment decontamination activities should also be conducted according to the field sampling plan and SOPs, or equivalent, similar to those used to guide sample collection activities for the RI.
- Care should be taken to not disturb the sediment surface during surface water sample collection.

## **4.8 INSTITUTIONAL CONTROLS**

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ICs that prevent or limit exposure to contaminants and maintain containment integrity of caps on both a short- and long-term basis are proposed as a component of the proposed action.

### **4.8.1 Fish Consumption Advisories**

- Fish consumption advisories would be required until such time as RAO 2 is achieved.
- Outreach would be conducted to educate the public about the fish consumption advisories using informational materials.
- Surveys of fish consumption patterns would be conducted to determine advisory effectiveness.

#### **4.8.2 Waterway Use Restrictions or Regulated Navigation Areas (RNAs)**

Where caps will be used to contain contamination, waterway use restrictions or RNAs or other types of use restriction mechanisms may be used to maintain the integrity of the cap.

- This will include prohibiting anchoring of vessels or the use of spuds to stabilize vessels in areas containing caps.
- Notifications, such as signs and buoys, placed by the Oregon Marine Board may be used to warn vessels from the area.
- Periodic inspections of RNA notifications or the use of restriction mechanisms will be needed to ensure they are functional and effective.

#### **4.8.3 Land Use/Access Restrictions**

Land use or access restrictions may need to be implemented in nearshore areas and river banks to maintain the integrity of caps. Depending on who owns the land being remediated, an equitable servitude and easement or some other proprietary control may be used to establish necessary use restrictions. As discussed above, RNAs or another mechanism implemented by the Oregon Department of State Lands (DSL) may be used on publicly owned submerged lands. Monitoring, including inspections, will be needed to ensure that restrictions are functioning as intended.



## 5.0 COMPENSATORY MITIGATION

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During remedial design, SMA-specific remedial activities and SMA-specific avoidance and minimization measures would be fully developed. Based on those detailed plans, the need for compensatory mitigation projects to address the habitat functions potentially impacted by the SMA-specific remedial activities would be determined. Opportunities for mitigation projects that match the type and scale of impacts in the Site would be evaluated. It is anticipated that the applicable parties would formally propose individual or group mitigation project(s) to fulfill the requirements identified.

As described in Section 5.4, several on-site habitat avoidance and minimization measures would be implemented following remedial activities to avoid the need for compensatory mitigation. For purposes of this FS, a programmatic approach was used to estimate compensatory mitigation requirements. The FS assumes that a certain amount of compensatory mitigation for remedial technologies would be implemented in shallow water (0 to 20 feet MLLW) habitat as determined by changes to water depth and substrate. This is a useful and straightforward assumption for the purposes of the FS, which is not expected to greatly impact the selection of the preferred alternative by EPA.

Compensatory mitigation would be required to offset impacts due to the loss of approximately 15 acres of aquatic habitat with construction of a CDF at Terminal 4.

### Calculating Required Compensatory Mitigation

During remedial design, determination of required compensatory mitigation will be based on an evaluation of the area impacted and the functions impacted by actions taken in the SMA. Perhaps the most significant habitat function of much of the Site is for fish rearing and migration habitat. The compensatory mitigation calculations will include an approach that relates existing habitat to the highest functioning rearing and migration habitat and provides mitigation acreages relative to the creation of this highest functioning habitat. Highest functioning habitat is defined as off channel, shallow water, or ACM with a gentle slope (shallower than 5:1), habitat complexity in the form of large woody debris (LWD), and sand and gravel substrate.

A mitigation approach was developed for the Site in coordination with NMFS that is based on a Habitat Equivalency Analysis (HEA) method for salmonids. HEA compares existing habitat functions to proposed habitat functions (after remediation) within the same area using relative habitat values (RHVs). The difference between existing and proposed function represents either an increase in ecological function (mitigation credit) or a decrease in ecological function (a mitigation debit that would require compensatory mitigation).

The HEA method quantifies resources using scoring such as those developed by the Portland Harbor Natural Resource Trustee Council (PHNRTC) and NMFS (PHNRTC 2010). Habitat characteristics typically evaluated in calculating RHV scores include type and extent of riparian habitat, slope and substrate of the active channel margin, depth and

substrate of the main channel area, and characteristics of off-channel habitat.

The following functions and the corresponding indicators that may be used in the development of RHVs for the mitigation framework include:

- Rearing: Cover/Refugia and Forage
  - Substrate (with overwater/in-water structure modified scores)
  - Water depth zone
  - Shoreline complexity (slope and LWD)
  - Riparian and overhanging vegetation
- Connectivity (migration and movement)
  - Water depth zone (with overwater/in-water structure modified scores)
  - Shoreline complexity (slope and LWD)
  - Riparian and overhanging vegetation

Aquatic species in the Lower Willamette River have diverse habitat requirements that support their survival, growth, and reproduction. In the case of Pacific salmonids, a complex of anadromous species, the habitat requirements include not only the above but also freshwater and marine migratory pathways necessary to complete their life cycles. The Site affected by the remedial actions is used by Pacific salmonids for juvenile rearing and migration to and from natal streams as well as by multiple life stages of many other aquatic and aquatic-dependent species, including birds (such as osprey) and mammals (such as mink). However, the habitat in the Site does not typically provide the primary constituent elements (PCEs) (other than forage) that define critical habitat for salmonids (NMFS 2005c). Because salmon do not spawn in the Site, that function is not included in the functional assessment. The rearing and migration (or connectivity) requirements are the focus of the functional assessment used to derive RHVs for the purposes of assessing the impacts from remedial alternatives using the mitigation framework.

The rearing cover/refugia subfunction relates directly to natural cover, floodplain connectivity (ability to relocate to low velocity areas during flood events), and water quality (temperature) critical habitat PCEs that are part of freshwater rearing sites. The rearing forage subfunction relates directly to the forage PCE that is part of freshwater rearing sites. Finally, the connectivity (migration and movement) function relates directly to factors such as being free of artificial obstructions, suitable natural cover, and water quality (temperature) PCEs that comprise freshwater migration sites.

To score existing habitat condition, geographic information system (GIS) information for

water depth, substrate type and shoreline complexity (slope and LWD), and riparian vegetation will be evaluated for each of the SMAs during remedial design. Anticipated post-remedial action habitat condition would be assessed in the same manner, and the difference in scores would be used to estimate the acres of compensatory mitigation that would be required to mitigate for impacts to salmonids.

Impacts to other functions must also be mitigated. The resources and functions present in each SMA will be identified during remedial design but may include elements such as recreational access, flood storage and floodplain functions, navigation, fish and wildlife habitat functions other than those important to salmonids, and aesthetics. Depending on the impacted resource or function, compensatory mitigation may include restoration or creation of new areas with similar acreage and functions or replacement of flood capacity. Generally, when calculating the amount of compensatory mitigation for habitat impacts, additional mitigation is required to account for temporal impacts and delays in the establishment of the mitigation site.

## **5.1 IDENTIFICATION OF COMPENSATORY MITIGATION OPPORTUNITIES**

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General compensatory mitigation requirements (40 CFR 230.93) provides a hierarchy for selection of compensatory mitigation projects. The hierarchy in order of priority is:

- Purchase of mitigation bank credits
- Purchase of credits from an in-lieu fee program
- Permittee-led mitigation conducted on a watershed scale (based on a watershed plan or approach)
- Permittee-led mitigation through on-site (area located on the same parcel or contiguous parcel) and in-kind (i.e., replacement of a resource type similar in structure and functional type) mitigation
- Permittee-led mitigation through off-site (area located either on a different parcel of land and not contiguous to the impact site) and/or out-of-kind (replacement of a resource that is of a different structural or functional type) mitigation

In considering the impacts of the remedial technologies to be implemented, “on-site” is assumed to be within the Site and “off-site” would be within the appropriate watershed of the impact. Consistent with DSL mitigation bank requirements, compensatory mitigation would be implemented in the fourth level hydrologic unit code (HUC) watershed (the Lower Willamette Sub-basin, HUC 17090012).

For the purposes of the Site and the remedial action, purchase of mitigation banking credits is contingent upon establishment of a bank within an appropriate service area. As of March 2016, there were no established banks with available credits that cover the Site or the overlap of the fourth level watershed (USACE 2016). Mitigation banking sites

must be approved to provide compensatory mitigation for Section 404 impacts and not just Natural Resource Damage Assessment values.

As reflected in the hierarchy, mitigation banking may be a cost effective and ecologically sound way to compensate for unavoidable losses of aquatic resources. Purchasing mitigation credits reduces schedule and project costs by eliminating development of mitigation plans, multiple agency reviews of mitigation actions, and finding and acquiring land, among other steps necessary to conduct on-site or off-site mitigation. However, if mitigation banking credits are not available, alternative mitigation projects would be developed based on SMA-specific plans during remedial design.

It is assumed that compensatory mitigation projects would be constructed in the Lower Willamette River and/or the Lower Columbia River. These projects most likely would entail the conversion of existing upland habitat to shallow water habitat with sand/gravel substrates, shallow slopes, and shoreline complexity.

## **6.0 ANALYSIS OF PRACTICABLE ALTERNATIVES PURSUANT TO SITE CRITERIA**

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The FS provides the analysis of practicable alternatives pursuant to the CERCLA criteria. Remedial alternatives considered in the FS are described in Section 2.2.1 of this document and summarized in **Table 2-1**. **Table 2-2** summarizes the comparative analysis of remedial alternatives conducted in the FS. As stated earlier, the purpose of the proposed action is to remediate the contaminated sediments at the Site to reduce risks to acceptable levels consistent with the RAOs. The FS evaluates the available alternatives, including discharge locations, capable of achieving this project purpose consistent with 40 CFR 230.10(a). Based on the FS evaluation, and as described in Section 2.2.2 of this document, the proposed action (Alternative I) is the alternative, consistent with the CERCLA criteria, that is most available and capable of achieving the project purpose in a manner that is designed to avoid unacceptable adverse impacts to the aquatic ecosystem to the maximum extent practicable. However, given that in-water disposal is not water dependent, a more detailed 404(b)(1) practicable alternatives analysis to an on-site confined disposal facility is addressed in more detail here.

The subsections below summarize the findings of the FS relative to the CWA Section 404(b)(1) alternatives analysis criteria.

### **6.1 SITE AVAILABILITY**

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Pursuant to the CWA Section 404(b)(1) regulations, an alternative is practicable if it is available to meet and capable of meeting the project purpose, among other considerations. According to the regulations (40 CFR 230.1(a)(2)), “an area not presently owned by the applicant, which could be reasonably obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered.” EPA has determined that an alternative would be available if it is owned or could be reasonably obtained, used, expanded, or managed by the individual responsible parties. For the purposes of the FS, site ownership and access to the remedial action areas was not addressed, and it is assumed that neither will be an impediment to the actions.

The following sections describe the evaluation of disposal scenarios and CDF locations conducted for the FS.

### **6.2 COST EFFECTIVENESS**

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Pursuant to the CWA Section 404(b)(1) regulations, a determination of practicability must consider if fill or disposal can be accomplished at a reasonable cost (40 CFR 230.10(a)(2)). The proposed action and the other alternatives would involve fill. Under CERCLA, EPA also must consider whether or not an action or remedy provides effectiveness proportional to costs. To determine cost effectiveness, the costs of the alternatives and their protectiveness were compared and considered in light of the project purpose. That analysis was conducted as part of the FS, and indicated that the longer duration, more expensive alternatives have lower cost effectiveness. The FS conclusions

on cost effectiveness are presented in Section 4 of the FS. **Table 2-2** summarizes the comparative analysis of remedial alternatives conducted for the FS.

The FS Section 4 presents an analysis of disposal scenarios based on cost and finds that DMM Scenario 1 (which includes the CDF) represents a potential cost savings for each eligible alternative (Alternatives E through I) if it were to be implemented. A large capacity CDF (e.g., Terminal 4 CDF) could be efficiently integrated with dredging because it would result in shorter transport distances and minimize the need to off-load at an offsite landfill.

The FS Section 2 (**Table 2.4-2**) describes the results of the screening evaluation of the three potential CDF locations with respect to cost and finds that costs would be “high” for the Terminal 4 location, “high-very high” for Swan Island Lagoon and “very high” for Arkema. **Table 2.4-3 of the FS** states that capital and operation and maintenance (O&M) costs for a Terminal 4 CDF would be approximately \$87/cubic yard and \$1.5 million, respectively, based on the 60 percent design (Anchor QEA 2011). Estimated capital and O&M costs for a CDF at Arkema would be \$166/cubic yard and \$245,000, respectively. No cost estimates are available for a CDF at Swan Island Lagoon and were not developed in the FS.

The proposed action (Alternative I) selected by EPA in the ROD and as further developed for each SMA during remedial design is the alternative (consistent with CERCLA’s cost-effectiveness criteria) most available and capable to achieve the project purpose in a manner that is designed to avoid unacceptable adverse impacts to the aquatic ecosystem to the maximum extent practicable.

## 6.3 FEASIBILITY

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When considering technical and administrative feasibility, the proposed action is the alternative most available and capable of achieving the project purpose in a manner that is designed to avoid unacceptable adverse impacts to the aquatic ecosystem to the maximum extent practicable.

### 6.3.1 Technical Feasibility

The FS compares the proposed alternatives against implementability and technology screening criteria (see FS Sections 3 and 4). Unproven technologies are generally screened out early in the FS such that for all of the proposed alternatives, construction would be implementable using existing technologies. Despite all alternatives being implementable, the larger and more complex the project, the more difficulties and uncertainties will arise with implementation of that alternative. **Table 2-1** summarizes the proposed scope of each alternative with respect to acres and volumes. Alternatives having the largest amounts of dredging and capping and the longest durations would be the most difficult to implement. See **Table 2-2** for a summary of the comparative analysis of remedial alternatives conducted in the FS.

The FS Section 2 provides an evaluation of the three potential CDF locations: Terminal 4

(Slip 1), Swan Island Lagoon, and Arkema. Table 2.4-3 of the FS describes the results of the evaluation of these three sites based on effectiveness (long- and short-term), implementability (administrative and technical feasibility), and cost. Findings for effectiveness and implementability are as follows:

**Effectiveness:** A CDF at either the Terminal 4 or Swan Island Lagoon locations would be effective (both short- and long-term) if constructed and maintained properly. A CDF at the Arkema location may not be effective due to high levels of contamination offshore of Arkema and the presence of an uneven bedrock surface.

**Implementability:** A CDF at either the Terminal 4 or Swan Island Lagoon locations would be technically feasible based on the 60 percent design. No significant issues related to the location in the off channel area were identified that cannot be overcome through design. A CDF at Arkema would require rigid containment due to its location in the channel. In addition, basalt bedrock near the surface and deeper water near the navigation channel create challenges for isolation of contaminants with rigid containment at the Arkema location. It is uncertain if these challenges could be overcome.

### 6.3.2 Administrative Feasibility

Administrative feasibility refers to the requirements associated with coordinating with other offices and agencies, including statutory limits, waivers, and requirements for off-site actions.

The FS considers the administrative feasibility as a component of the implementability criteria used to evaluate the alternatives. Administrative requirements include permitting, maintaining caps over time (e.g., implementation of Restricted Navigation Areas with the Coast Guard and coordination with DSL on lease agreements), and coordination with resource agencies on long-term monitoring of mitigation sites. The specific details of administrative implementability are presented in FS Section 4. The FS concludes that the proposed action is administratively feasible.

Construction and maintenance of a CDF (at any location) presents administrative challenges, as described in Section 4 of the FS. Construction of a CDF would increase the relative amount of construction for Alternatives E through I, and would require sequencing remedial projects for effective CDF use. There could also be potential disruption of navigation and other waterway uses throughout construction, filling, and closure of the CDF. Administrative challenges would include obtaining agreements among multiple parties for CDF use, costs, maintenance, and liability. Despite these administrative challenges, the CDF option is considered to be feasible in the FS.

As described in Table 2.4-3 of the FS, there are proponents identified for construction of a CDF at both the Terminal 4 (Port of Portland) and Arkema (LSS/Arkema) locations, but no current proponent exists for the Swan Island Lagoon location. The Port of Portland (and to some extent LSS/Arkema) have been in discussions with the Oregon Department of State Lands, who owns the lands within the footprint of the Terminal 4 and Arkema

CDF locations. This may indicate greater administrative feasibility of the Terminal 4 location.

In addition, following completion of a CDF at Terminal 4, it may be possible for the Port of Portland or its tenants to utilize the land created by the CDF for water-dependent uses.

Use of the potential Swan Island CDF would eliminate or impact ongoing commercial water-dependent uses of this portion of the Site unless the channel end of the CDF was repurposed as a terminal slip. However, there is a lack of information on whether these potential uses are viable due to a lack of a proponent.

#### **6.4 AQUATIC IMPACTS FROM DISPOSAL**

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Potential aquatic impacts have been discussed extensively in Section 3 of this analysis. Of the remedial technologies to be implemented, dredging would result in the most adverse impacts on water quality and the aquatic environment. However, dredging would result in the removal of contaminants from the aquatic ecosystem. Due to site constraints, capping would be necessary in some places. Both dredging and capping would result in the discharge of materials into the aquatic environment in order to isolate any dredge residuals and remaining contaminated sediment. However, the long-term result of these activities would be an improvement in the aquatic environment.

Construction of the CDF would result in permanent loss of approximately 15 acres of aquatic habitat. As described further in Section 7.6, the use of a CDF has the potential to reduce overall impacts to the environment compared to complete upland disposal of all removed sediments.

Upland disposal would not be permitted in areas with wetlands, streams, or other aquatic resources; therefore, there would not be any impacts on the aquatic environment from the upland disposal of material.

#### **6.5 CONSERVATION AND RECOVERY**

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Section 5.4 of this document provides habitat avoidance and minimization measures that would be implemented following dredging and capping to avoid the need for compensatory mitigation. Section 6 describes the process for determining compensatory mitigation to account for unavoidable losses to aquatic functions.

#### **6.6 LIMIT NUMBER OF SITES**

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The location of discharge into the Site includes the active remediation areas as well as the location of the CDF. The sizes and locations of the remedial action areas were determined through application of risk-based screening. This process is described in detail in the FS Section 4.

The technology screening process for disposal sites was conducted to assess a number of possible alternatives through the application of the effectiveness, implementability, and



cost criteria. Upland disposal sites considered as representative locations in the FS include Roosevelt Regional Landfill (Subtitle D), and Chemical Waste Management of the Northwest (Chem Waste) Landfill (Subtitle C; accepts RCRA waste). As described in Section 2.3.8.1 and shown in Figure 2-1, a number of potential transloading facilities along the Columbia River are being considered as part of the disposal process.

The Port of Portland evaluated the use of a CDF at Terminal 4 in an engineering evaluation/cost analysis (EE/CA) (BBL 2004a, 2004b). Based on an evaluation of effectiveness, implementability, and cost, a CDF in Slip 1 of Terminal 4 was identified as a component of a preferred alternative that would be the least environmentally damaging practicable alternative for the removal action.

The Terminal 4 EE/CA and associated 404(b)(1) Analysis (BBL 2005) found that a CDF with excess capacity (beyond what was needed for the sediments removed at Terminal 4 itself) may facilitate more expedited sediment cleanup of the Site by providing additional disposal options for future cleanup decisions. Establishing an in-water disposal site within the Portland Harbor Site would reduce the overall environmental impacts and potential public safety implications associated with transport of materials to offsite disposal facilities. Having one or more disposal options for the Site also helps control the costs of disposal because it would create a more competitive market for disposal. This, in turn, would make dredging and removal of contaminated sediment a more cost effective remedy and encourage the consolidation of the contaminated sediments into a limited number of locations, which may reduce the area within the Willamette River where contaminated sediments would be contained in place.

In addition, by constructing the CDF to an at-grade surface, the newly gained land could be used for water dependent commercial purposes. Based on the EE/CA, the area affected by the CDF would create 17 acres for water-dependent use consistent with Port's strategy to improve marine facilities for tenants at Terminal 4. Marine loading and offloading facilities could be modernized and relocated to the riverfront, increasing efficiency of maritime operations by shifting bulk loading and unloading operations from berths in the slips to berths on the main navigation channel. This would strengthen the Port's competitive position and ability to promote regional economic vitality (BBL 2005).

Potential on-site (CDF) locations were identified, as described in Section 2.3.8.2, with the Terminal 4 location further evaluated to 60 percent design by the Port of Portland (BBL, Inc. 2005; Anchor QEA. 2011). The FS Section 2 provides an evaluation of the three potential CDF locations: Terminal 4 (Slip 1), Swan Island Lagoon, and Arkema, as described above. Based on the analysis presented in Section 2 of the FS (as summarized in Tables 2.4-2 and 2.4-3 of the FS and described above), the Terminal 4 CDF location was retained as the representative option.

## **7.0 FACTUAL DETERMINATIONS**

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The following sections provide a summary of the determinations made for each component of the aquatic ecosystem evaluated in previous sections.

### **7.1 PHYSICAL SUBSTRATE DETERMINATIONS**

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Remedial activities, including dredging, capping, in-situ treatment, ENR, removal and installation of piles and structures, and disposal of contaminated sediments in a CDF, will alter the material composition, slope, and elevation of the physical substrate. Elevation, slope, and substrate would be restored to the extent possible, and the placement of clean sand residuals cover and/or beach mix will provide an improvement over current physical substrate conditions in some locations by replacing anthropogenic debris or large rock with sand and/or gravel. In areas where armoring is required, adverse impacts to substrate would occur; however, re-deposition of fine-grained material in capped and armored areas is anticipated to occur over time, making the armored areas similar in surface grain size to non-armored areas. Compensatory mitigation to replace lost habitat and forage area from the placement of armor stone would be required to replace lost habitat and forage area and to compensate for other lost functions such as flood capacity, as described in Section 6.

### **7.2 WATER CIRCULATION AND FLUCTUATION DETERMINATIONS**

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Following dredging in nearshore areas, elevations would be restored to pre-dredge conditions, and the placement of remediation fill materials in shallow areas would require dredging of an equivalent cap thickness (maximum of 3 feet) prior to placement to allow for a net zero bathymetry change and avoid loss of shallow water habitat. Therefore, impacts on currents, water circulation, and normal water fluctuations from these activities are anticipated to be negligible.

Impacts on floodplain storage from the construction of a CDF is anticipated to be negligible based on HEC-2 modeling (BBL 2005).

### **7.3 SUSPENDED PARTICULATES AND TURBIDITY DETERMINATIONS**

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Impacts on water quality are anticipated to be greatest from debris removal and dredging compared to other remedial activities. Turbidity increases and DO decreases during debris removal and dredging are expected to be limited, short-term, and localized and would be minimized with the implementation of BMPs and avoidance and minimization measures described in Section 5. Water quality parameters will be monitored at the compliance boundary of 100 meters, and activities will be suspended if levels exceed regulatory thresholds established for the proposed action.

### **7.4 WATER QUALITY DETERMINATIONS**

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Physical disruption of the contaminated sediments during debris removal and dredging could cause a temporary increase in dissolved phase concentrations of some chemicals in

the vicinity of dredging activities, resulting from resuspension of contaminated sediments, desorption of the contaminants from sediment particles to pore water, and release of contaminated pore water into surface water. Short-term (during construction) increases in water column concentrations is expected to occur intermittently during the duration of the dredging and dissipate when dredging ceases. Water quality parameters will be monitored at the compliance boundary of 100 meters, and activities will be altered or suspended if levels exceed regulatory thresholds established for the proposed action.

## **7.5 AQUATIC ECOSYSTEM AND ORGANISM DETERMINATIONS**

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Dredging activities will have temporary and localized adverse impacts on the aquatic ecosystem and organisms in the immediate dredging plume area. Remedial activities that disturb the sediment surface will temporarily remove the biologically active zone and associated benthic communities. Recovery times for benthic communities following remedial activities are expected to be on the order of months. In many areas, the physical and chemical improvement in substrate type as a result of the removal of contamination and placement of the dredge residuals layer may promote a more productive benthic community through recolonization on uncontaminated material. However, the placement of armor as a surface layer on top of an existing sand or gravel beach substrate in shallow water areas would lead to a long-term impact on benthic communities that were established in the sand/gravel substrate. While re-deposition of fine-grained material in capped and armored areas is anticipated to occur over time, adverse impacts would require compensatory mitigation, as described in Section 6.

Based on the analysis in the Programmatic BA, remedial activities are likely to adversely affect listed species and designated critical habitat at the Site. Compensatory mitigation would be required for impacts to listed species and designated critical habitat.

## **7.6 DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM**

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Cumulative impacts are defined as “the changes in an aquatic ecosystem that are attributable to the collective effect of a number of individual discharges of dredged or fill material. Although the impact of a particular discharge may constitute a minor change in itself, the cumulative effect of numerous such piecemeal changes can result in a major impairment of the water resources and interfere with the productivity and water quality of existing aquatic ecosystems” (40 CFR 230.11[g][1]).

As described in the earlier sections of this document as well as in the RI (LWG, as modified by EPA 2016), the Site has been significantly modified by human activity in the last 100 years, resulting in present-day conditions that are highly altered and degraded. Maintenance dredging activities in the federal navigation channel, undertaken by USACE, have occurred in the past and would be expected to occur in the future.

In all alternatives, some mix of removal and in-place technologies (placement of remediation fill) will occur. Under each alternative, it is assumed that only a certain

number of projects can be completed during the specified in-water work window each year. The implementation of avoidance and minimization measures and BMPs described in Section 5 would avoid or reduce impacts on the aquatic ecosystem to the maximum extent possible.

Construction of a CDF at Terminal 4 would result in the loss of 15.3 acres of total aquatic area, including approximately 3.1 acres of shallow water (i.e., <20 feet deep), 11.5 acres of deepwater, 0.2 acres of vegetated shallows or wetlands, 3.5 acres of inundated piling areas, and 3,317 linear feet of shoreline which is comprised of various structures, unclassified fill, seawalls, and riprap (BBL, Inc. 2005). Shallow water habitat and vegetated shallows or wetlands are limited habitats in the Lower Willamette River, with approximately 20 percent of the Site having shallow water habitat (LWG, as modified by EPA 2016). Based on this rough estimate, there are approximately 438 acres of shallow water habitat in the 2,190-acre Site. As described in Section 3, high quality shallow water habitat with emergent vegetation, refugia, and appropriate substrate to support benthic forage opportunities is very limited in this industrial setting and likely impacted by the presence of chemical contamination. However, given the limited availability of shallow water habitat and its importance for juvenile salmon and other species, any loss of shallow water habitat would be a significant loss that would require compensatory mitigation.

The proposed action, together with past and reasonably foreseeable future actions, will not result in significant detrimental cumulative impacts on the aquatic ecosystem. Although short-term adverse effects from implementation of remedial activities are expected, the proposed action would result in long-term benefits to the aquatic ecosystem by reducing exposure to contaminants in sediment, porewater, and surface water. SMA-specific actions and required compensatory mitigation, to be defined during remedial design, are expected to result in “no net loss” of aquatic resource functions.

## **7.7 DETERMINATION OF SECONDARY EFFECTS ON THE AQUATIC ECOSYSTEM**

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Secondary effects (or impacts) are “effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials but do not result from the actual placement of the dredged or fill material” (40 CFR 230.11(h)(1)). Under CWA, secondary impacts are generally interpreted as indirect impacts; therefore, secondary effects are limited to other actions in the aquatic environment that are indirectly related to implementation of the action, such as erosion or downstream sedimentation, or compensatory mitigation. The remedial alternatives would be designed so that they would not contribute to erosion or downstream sedimentation.

It is assumed that compensatory mitigation will be required to be in compliance with CWA Section 404(b)(1) as well as to offset potential impacts on listed species. The compensatory mitigation could be in the form of purchase of mitigation banking credits that may or may not be for SMAs located in the Site. It could also entail construction of mitigation projects in the Site or within the larger watershed. Compensatory mitigation

activities will not cause other significant impacts to occur that would adversely affect the aquatic environment in the Site.

## **7.8 EVALUATION OF IMPACTS ON RECREATIONAL, AESTHETIC, AND ECONOMIC VALUES**

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Recreational, aesthetic, and economic existing conditions within the Site are discussed in Section 3 of this evaluation. It is anticipated that the implementation of remedial activities would result in short-term, negligible impacts on these human use components. In the long term, recreational values may be beneficially impacted in terms of public use and access once the sediments in the Lower Willamette River have been cleaned up.

Conducting a remedy in the Portland metropolitan area has the potential to be economically significant. It is anticipated that much of the work may be conducted by local companies and materials may be sourced locally when practicable. At other sites, remediation has had a positive impact on the local economy (Department of Environmental Conservation of New York State 2011). Conversely, implementation of a remedy that involves substantial disruption to navigation through extended periods of closure could have a negative impact on the economy of the region.

## **8.0 REVIEW OF CONDITIONS FOR COMPLIANCE**

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The potential for significant adverse impacts on the aquatic ecosystems resulting from implementation of remedial alternatives would be mitigated through the application of avoidance and minimization measures and compensatory mitigation described in Sections 5 and 6. According to the compensatory mitigation regulations:

“...no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences” (40 CFR 230.10 (a)).

The alternatives with the most potential for significant adverse impacts on the aquatic ecosystem are Alternatives E through I, which include construction of a CDF. As described in this document, the proposed action (Alternative I) is the alternative most available and capable to achieve the project purpose in a manner that is designed to avoid unacceptable adverse impacts to the aquatic ecosystem to the maximum extent practicable.

### **8.1 AVAILABILITY OF PRACTICABLE ALTERNATIVES**

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Section 230.10 of Subpart B of the compensatory mitigation regulations further specifies four general conditions that must be met for compliance. These include consideration of practicability, compliance with the ESA, protections for water quality and human uses, and compliance with the avoidance, minimization, and compensatory mitigation requirements. The results of the analyses are summarized below.

#### **8.1.1 Practicability (40 CFR Section 230.10(a))**

A practicable alternative according to 40 CFR 230.10 is available and capable of being conducted after taking into consideration cost, existing technology, and logistics in light of the overall project purpose and needs. Activities that do not involve a discharge of material into waters of the United States (e.g., Lower Willamette River) include Alternative A (No Action). However, according to the proposed RAOs and purpose and need of the remedial action, this alternative does not meet the purpose and need and is not considered to be available per 40 CFR 230.10.

Each of the action alternatives are evaluated for compliance with the definition of practicability in the FS, as described in Section 2 of this document. The proposed action alternatives were found to be practicable.

Three potential CDF locations were also evaluated in the FS, and the results are summarized in Section 7 of this document. A CDF could be used for disposal of some of the dredged sediments under Alternatives E through I. The FS analysis found that a CDF at Terminal 4 is practicable as part of the proposed action.

#### **8.1.2 Compliance with Water Quality Standards and ESA and Protection of**

### **Habitat (40 CFR Section 230.10(b))**

Based on the evaluation of impacts in Section 3 of this document, the remedial alternatives have been assessed for their direct cause of or contribution to significant degradation of waters of the United States. Under 40 CFR 230.10(c), special emphasis on the persistence and permanence of the effects is considered in making the significant degradation determination. The potential risk of release of pollutants as part of the implementation of the remedial alternatives is generally low; the nature of the remedial action itself is to remove pollutants from the aquatic environment.

The potential to release pollutants arises from the removal of material via dredging and less so as part of the discharge of fill for capping, in-situ treatment, or ENR. In general, the release of pollutants via ongoing contributions of existing contaminants in the sediments poses a greater potential risk than undertaking a particular remedial alternative. The proposed alternatives evaluation indicates that implementation of capping or dredging technologies will not result in substantial water quality exceedances and therefore will not result in significant degradation. Based on this evaluation and the FS, proposed Alternatives B through I will meet all applicable state water quality standards within appropriate compliance distances and durations and are generally not expected to violate any toxic effluent standard or prohibition under CWA Section 307.

Release of pollutants may occur during in-water disposal of dredged material into a CDF; however, these activities are expected to be designed to meet EPA disposal performance standards such that discharges of return water meet water quality standards. The CDF would be designed and constructed to prevent release of contaminants and long-term impacts on water quality. Long-term monitoring will include evaluating physical stability of the CDF berm during and following high flow and flood events and groundwater quality monitoring of the CDF and berm.

According to the determination of effects in the Preliminary Programmatic BA, the proposed action is likely to adversely affect listed species and designated critical habitat. Construction of the CDF would result in the loss of approximately 15 acres of aquatic habitat, and compensatory mitigation would be required, as described in Section 6. Activities would also comply with any additional terms and conditions imposed through site-specific reviews and consultation on potential impacts on listed species and critical habitat.

#### **8.1.3 Protections for Water Quality, Special Aquatic Sites, and Human Uses (40 CFR Section 130.10(c))**

These criteria involve prevention of significant degradation or significant adverse effects resulting from the discharge of pollutants on water supplies, fish and wildlife, aquatic organisms, and special aquatic sites; significant adverse effects on ecosystem diversity, productivity, or stability through the transfer of pollutants outside of the disposal site; and/or significant adverse effects on human use values (40 CFR 230.10(c)).

Alternatives B through I would result in minor impacts on wetlands, which would be

mitigated. Research suggests that other special aquatic sites (mudflats, vegetated shallows, coral reefs, and riffle and pool complexes) are either unlikely or not present in the Site; this includes sanctuaries. Sanctuaries and wildlife management areas are located outside of the Site, and direct or indirect effects on these resources are not anticipated.

Negligible to minor but temporary effects are expected on recreational and commercial fisheries, water-related recreation, and aesthetics. Impacts to cultural resources cannot be fully defined until remedial design on SMA-specific actions is completed; however, based upon initial research, it appears unlikely that cultural resources would be adversely affected by the alternatives.

Alternatives would affect navigation and other water-dependent activities by displacing berthing space and partially blocking navigation access during construction, and interrupting maintenance dredging. The use of a CDF would reduce impacts on navigation by reducing the distance that barges would need to travel to transport dredged sediment for disposal. The removal of contaminated sediment should support better maintenance of navigation in the long term. In addition, the Terminal 4 CDF would create 17 acres for water-dependent commercial purposes.

## **8.2 COMPLIANCE WITH PERTINENT LEGISLATION**

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Alternatives B through I are expected to comply with the Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Protection of Wetlands) and Oregon Environmental Cleanup Laws.



## 9.0 FINDINGS

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The proposed action is the least environmentally damaging practicable alternative that meets the project purpose and need. There are no practicable alternatives that avoid waters of the United States due to the location of the contaminated sediments. Disposal of dredged sediments would occur at upland locations or a combination of upland and CDF disposal. Based on the analysis presented in the FS and summarized in this document, the construction and use of a CDF presents a viable option that minimizes environmental impacts associated with transportation off-site. However, a CDF would result in unavoidable loss of aquatic habitat that would require compensatory mitigation.

The impacts of the proposed action are described on a programmatic level in this document. During remedial design, potential effects from SMA-specific actions would be assessed to verify the impacts are the same as described herein, or a supplemental 404(b)(1) evaluation would be required.

Avoidance and minimization measures and BMPs would be implemented during the remedial activities. In addition, avoidance and minimization measures would be implemented on site following remedial activities to restore substrate, slope, and natural cover to the extent possible to maintain habitats and functions that would be altered during implementation. Compensatory mitigation would be required to replace lost habitats and functions such that there would be “no net loss” of aquatic resource functions.

The proposed discharges associated with the proposed action are found to comply with the requirements of the Section 404(b)(1) Guidelines with the completion of the condition for mitigation. EPA, in consultation with NMFS, will ensure that the mitigation is completed.

Reviewed and Approved by:

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Sean Sheldrake

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Date

RPM

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